Appendix E

Local Transport and Traffic Management Strategy

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Cockburn Coast Local Transport and Traffic Management Strategy

14 May 2013

Hassell

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1. Introduction

1.1 Background

Parsons Brinckerhoff has been commissioned by Hassell to assess the traffic and transportation issues relating to the proposed Cockburn Coast development. The Cockburn Coast development is a mixed use development consisting of residential dwellings, commercial and retail space. There is the potential to construct a marina on this site, however this report assumes a 'no marina' scenario. The development consists of three precincts, Robb Jetty, Hill Top and Power Station.

The Cockburn Coast District Structure Plan (DSP) No. 2, was approved by the City of Cockburn in February 2012. The DSP Part 2 includes an Integrated Transport Plan (ITP) which sets forth the framework for future transportation improvements in the Cockburn Coast study area.

The ITP reflects the outcome of a collaborative effort of a number of stakeholders. The ITP was developed and endorsed through the Transport Planning Group which includes representatives from LandCorp, Department of Transport, Department of Planning, Main Roads WA, the Public Transport Authority, the City of Fremantle and the City of Cockburn. The ITP:

- incorporates the views of the many project stakeholders and takes account of relevant state and local government planning strategies impacting on the region
- outlines timely and achievable outcomes to provide local and regional planning certainty
- optimises the economic potential of the Cockburn Coast development to influence regional development and growth for integrated outcomes
- contains sufficient road and public transport system capacity to accommodate shifts and increases in travel demand
- balances the safety, efficiency and effectiveness of the local and regional transport network in a way that is appropriate and consistent with the approved DSP and transport network and
- provides clarity and certainty for Precinct Based Planning to proceed.

As such, the ITP provides the foundation for the following assessment of the movement strategy and parking being considered for the development. As a fundamental strategy, the DSP recommended the creation of a Bus Rapid Transit system (BRT) focussed on Cockburn Road and Hampton Road connecting the Fremantle CBD and train station with the project area. Buses using the BRT would also provide service to and from Murdoch Activity Centre and Rockingham. The DSP also recommended stations for the BRT be located within mixed use activity areas within the Cockburn Coast. Accordingly, the Cockburn Coast development will be served by the BRT and as such the development is considered to be a Transit Oriented Development.

In the short to medium term, the flexibility of bus rapid transit (BRT), its ability to offer similar service quality to rail (speed, reliability and comfort) and to provide certainty through investment in infrastructure while still being cost effective, resulted in BRT being the favoured approach to servicing the Cockburn Coast and surrounding communities. In the long term, it is the aspiration of LandCorp and the Cities of Cockburn and Fremantle that the alignment is served by light rail.

1.2 Location

The Cockburn Coast development area is located approximately 4km to the south of Fremantle and 18km southwest of the Perth CBD. The development area is approximately 330 hectares and is abutted to the north and south by the South Beach and Port Coogee urban renewal projects. The development site location in the context of the wider regional area is shown in Figure 1.1.

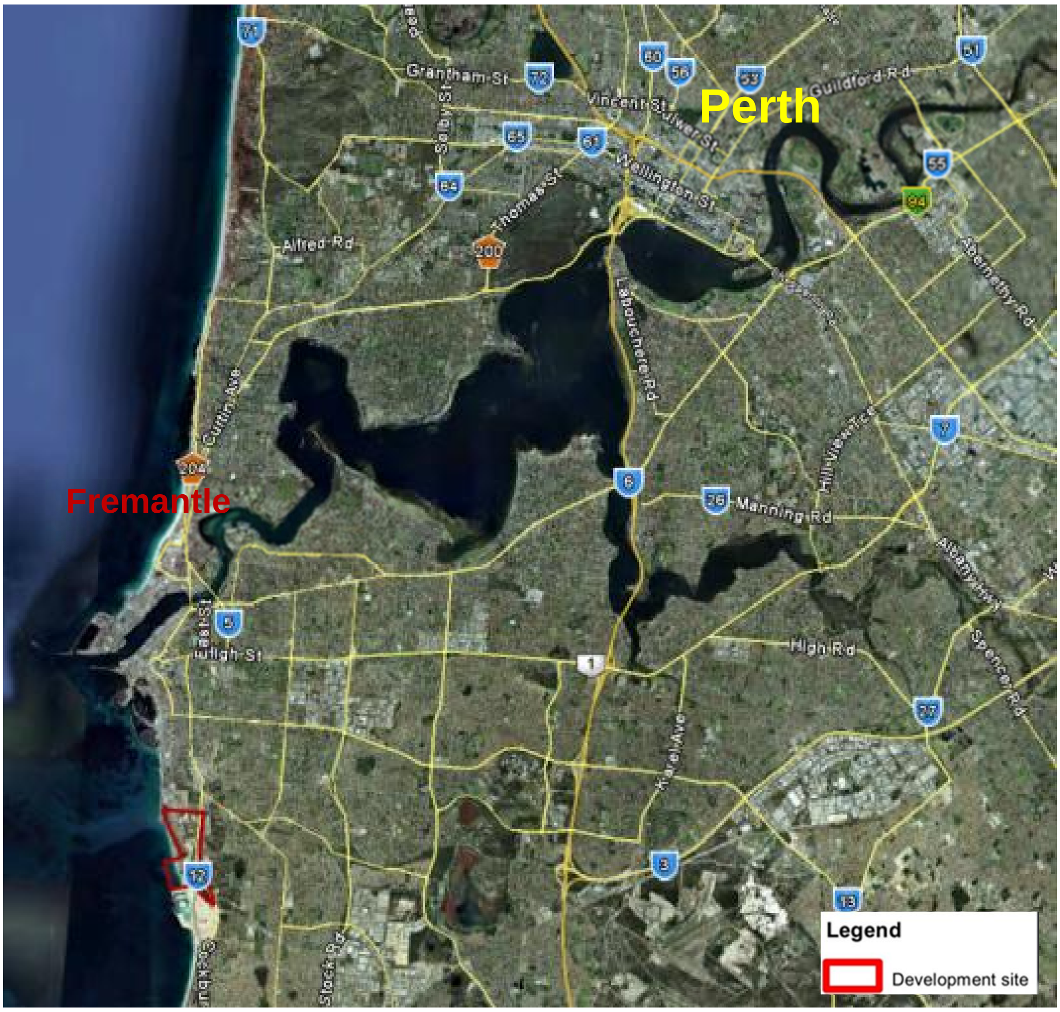

Figure 1-1 Development location *(Source: Landgate (SLIP, 2012))*

The study area that was originally proposed extended from south of Spearwood Avenue to Douro Road in the north, covering Cockburn Road to the east and Robb Road to the west. Following discussions with the City of Cockburn, the study area has been extended further north to include the South Street / Hampton Road intersection. A more detailed illustration of the study area is illustrated in Figure 1.2.

Figure 1-2 Development area and study area *(Source: Landgate (SLIP, 2012))*

1.3 Aim of this study

The aim of this Transport Assessment (TA) is to ensure that the development will:

- Provide safe and efficient access for all modes
- Be well integrated with the surrounding land uses
- Not adversely impact on the surrounding area
- Not adversely impact on the surrounding transport networks and the users of those networks

This TA has been produced in line with the Western Australian Planning Commission Transport Assessment "*Guidelines for Developments*" (August 2006).

2. The proposal

2.1 Regional context

As detailed in the DSP Part 2, Cockburn Coast is well located between economically significant centres, namely Fremantle, Rockingham, Kwinana and Henderson. It is also well connected to other major employment areas at Cockburn Central and Spearwood Industrial area. Within the South-West Sub-region, Rockingham is the principal centre of mixed use activity and is classified under Directions 2031 as a Primary Centre; Kwinana and Henderson are strategic industrial centres with a major focus on heavy industrial and export-oriented industry, employing over 10,000 workers. According to the employment targets set within Directions 2031, the south-west sub-region is expected to increase its employment self-sufficiency rate to 70% by 2031, requiring the creation of 41,000 new jobs, an increase from the already existing 52,000 in 2008. If the Cockburn Coast economy is to fully mature, it would provide a significant lift to the sub regional economy by improving the economy's competitive edge and value propositions on offer. In addition, it should directly contribute between 2,310 and 3,125 jobs (depending on the Scenario) towards the Directions 2031 employment target of 41,000 new jobs.

2.2 Proposed land uses

The Local Structure Plan boundaries and proposed land uses are illustrated in Figure 2.1 and the development yields for the Cockburn Coast development area are outlined in Table 2.1. These yields have been provided by Hassell and are the yields that have been assessed in this report.

In creating a projected yield for the Cockburn Coast area, a realistic take of the development status in the year 2031 has been made by Hassell. To begin, a base yield of 85% of the maximum capacity of the site has been created. It is necessary to calculate only 85% of the maximum potential of the site as a result of Amendment 89 to the City of Cockburn Town Planning Scheme No. 3. This amendment requires all development within the Cockburn Coast to achieve a minimum of 85% of the potential yield for any given site. It can thus be stated with certainty that 85% of the potential yield for the site will be present upon completion.

It is then necessary to consider what of this 85% of development will be present in 2031. It is predicted in 2031 that not all possible development will have occurred. Given the staging of development, timing of approvals and market characteristics it is likely that whilst a large percentage of the Robb Jetty precinct will be constructed, the Emplacement and Power Station precincts will not be as progressed. The yield projection makes the following assumptions on the staging of development.

In the year 2031:

- 50% of the Power Station precinct will be developed
- 60% of the Emplacement precinct will be developed
- 90% of the Robb Jetty precinct will be developed

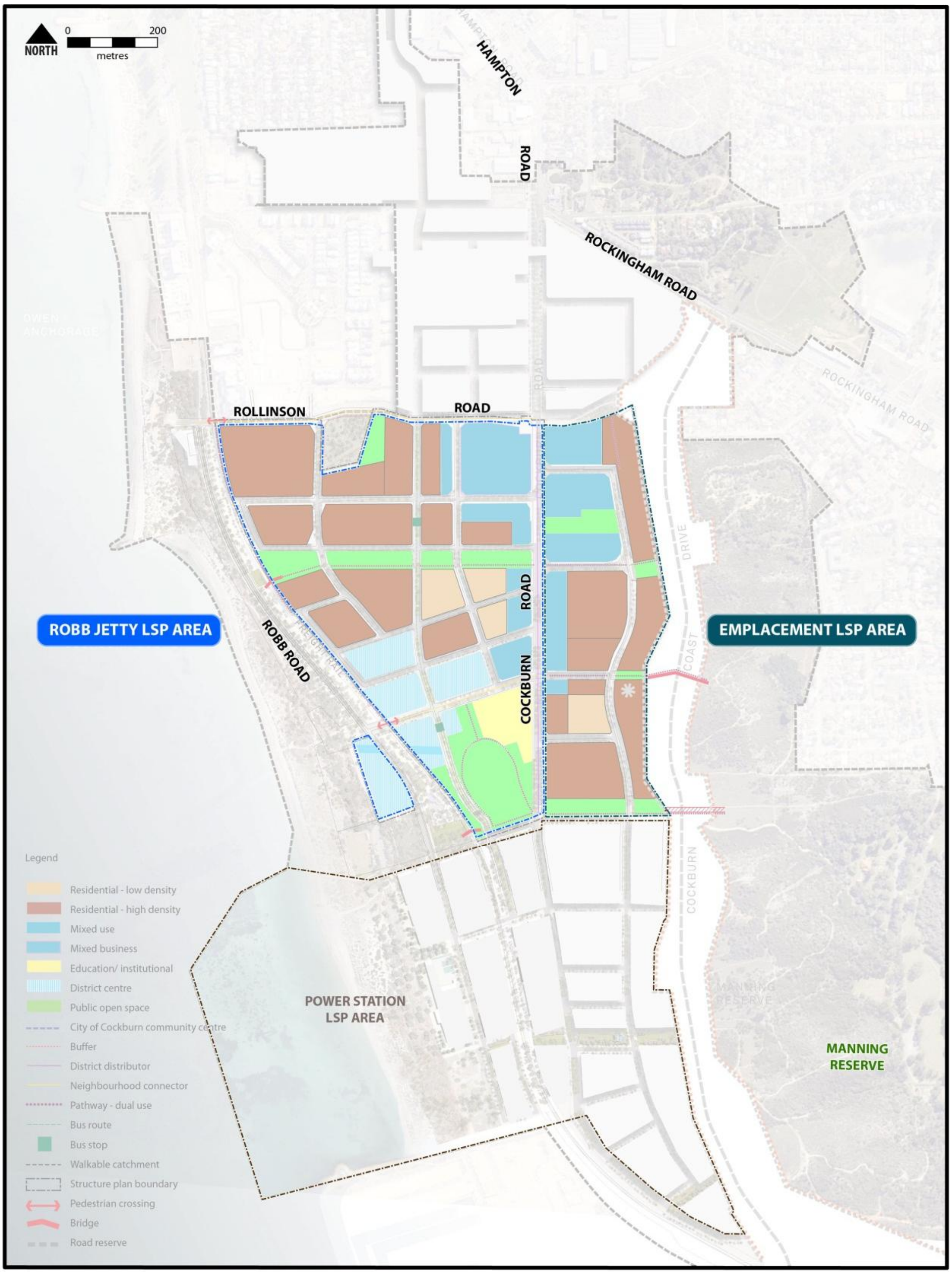

Figure 2-1 Proposed land use Robb Jetty and Emplacement precincts

Table 2.1 Yield summary

COCKBURN COAST TOTAL			
Land use type	**Residential units (dwellings)**	**Commercial area (sqm)**	**Retail area (sqm)**
Low density residential	433	0	0
Medium density residential	1,077	0	0
High density residential	749	0	0
Mixed use	293	22,228	8,335
Activity centre	614	41,023	11,710
Community / commercial	0	0	468
Total	**3,166**	**63,251**	**20,513**

The development will consist of a range of residential units along with Retail and Commercial areas. These will cover the Robb Jetty, Hill Top and Power Station precincts. Yields for each of the three precincts are detailed in Table 2.2.

Table 2.2 Individual precinct yields summary

ROBB JETTY PRECINCT			
Land use type	**Residential units (dwellings)**	**Commercial area (sqm)**	**Retail area (sqm)**
Low density residential	261	0	0
Medium density residential	812	0	0
High density residential	244	0	0
Mixed use	160	10,836	4,063
Activity centre	238	16,105	6,040
Community / commercial	0	0	468
Total	**1,715**	**26,941**	**10,571**

HILL TOP PRECINCT			
Land use type	**Residential units (dwellings)**	**Commercial area (sqm)**	**Retail area (sqm)**
Low density residential	116	0	0
Medium density residential	165	0	0
High density residential	484	0	0
Mixed use	119	8,063	3,024
Total	**884**	**8,063**	**3,024**

POWER STATION PRECINCT			
Land use type	**Residential units (dwellings)**	**Commercial area (sqm)**	**Retail area (sqm)**
Low density residential	56	0	0
Medium density residential	100	0	0
High density residential	21	0	0

POWER STATION PRECINCT			
Land use type	**Residential units (dwellings)**	**Commercial area (sqm)**	**Retail area (sqm)**
Mixed use	14	3,329	1,248
Activity centre	376	24,918	5,670
Total	**567**	**28,247**	**6,918**

In addition to the yields detailed above, a primary school is proposed in the Robb Jetty precinct. This has a total area of 15,260 sqm.

2.3 Major attractors / Generators

The Cockburn Coast Economic Development Strategy indicates that Cockburn Coast has a limited catchment as a result of its location on the edge of the ocean and with Manning Reserve to the east. The catchment of Cockburn Coast is further limited by the existing (and improving) offer of South Fremantle as a competing activity centre and by the competing activity centre in Port Coogee. A large proportion of trips are however still expected to originate from South Fremantle and Coogee, with areas such as Cockburn Central to the east also being a major attractor / generator of trips to the Cockburn Coast area.

3. Existing situation

3.1 Existing land uses within and surrounding Cockburn Coast

The Cockburn Coast development site is a former industrial area, housing the South Fremantle Power Station and switchyard. A small number of industrial uses are still in operation; however the majority of the land is suitable for redevelopment.

Although the site itself is a former industrial area, the surrounding areas are predominantly urban in nature. The surrounding areas of South Fremantle, Coogee, Hamilton Hill and Spearwood are existing residential suburbs. The surrounding land use is illustrated on Figure 3.1

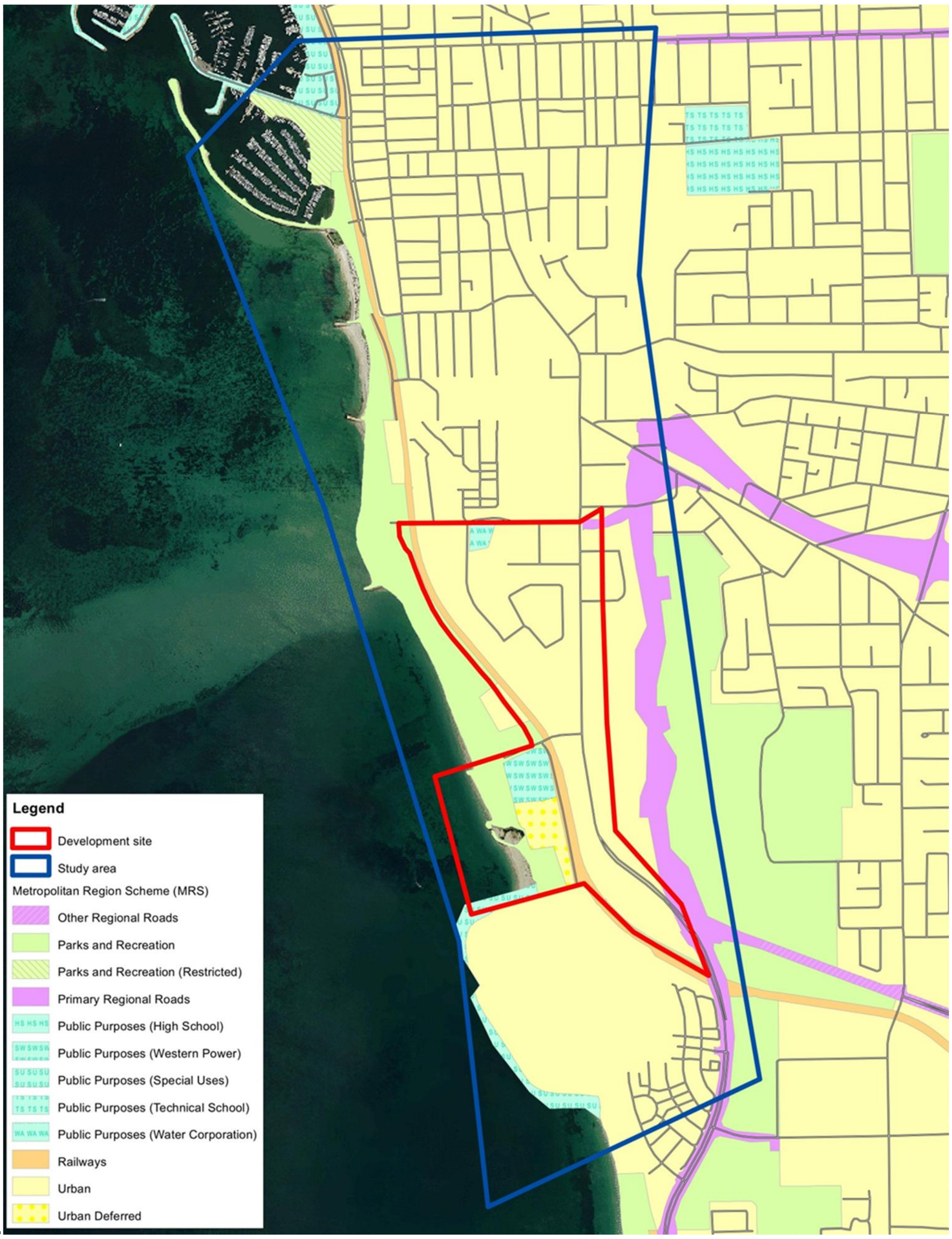

Figure 3-1 Surrounding land use *(Source: Landgate (SLIP, 2012))*

3.2 Existing pedestrian and cycle networks

There are already a number of pedestrian and cycle facilities within and surrounding the development area as shown in Figure 3.2.

There is a sealed shoulder on both sides of Cockburn Road to the southern end of the study area whilst a shared pedestrian / cycle path also runs from the south east of the study area along the coast to the northwest. Route SW10 which forms part of the Perth Bicycle Network enters the study area at Rockingham Road.

Although there are a number of pedestrian routes in the area, there are currently limited opportunities for pedestrians to cross Cockburn Road. Pedestrian stages are included in the signals at the intersections of Cockburn Road with Spearwood Avenue, Rockingham Road and Douro Road providing crossing points at these locations.

Figure 3-2 Existing cycle routes and facilities

(Source: Department of Transport, Perth Bike Map Series, Cockburn)

3.3 Existing public transport services within and surrounding Cockburn Coast

The bus services currently operating in the Cockburn Coast study area are illustrated on Figure 3.3 and detailed in Table 3.1. These services provide a connection to and from the Cockburn Coast area. Only one bus service (service 825) runs north – south along the extent of the Cockburn Coast study area however, operating between Fremantle Station and Rockingham Station. The frequency of this service is limited with a maximum of two services operating in the peak hours.

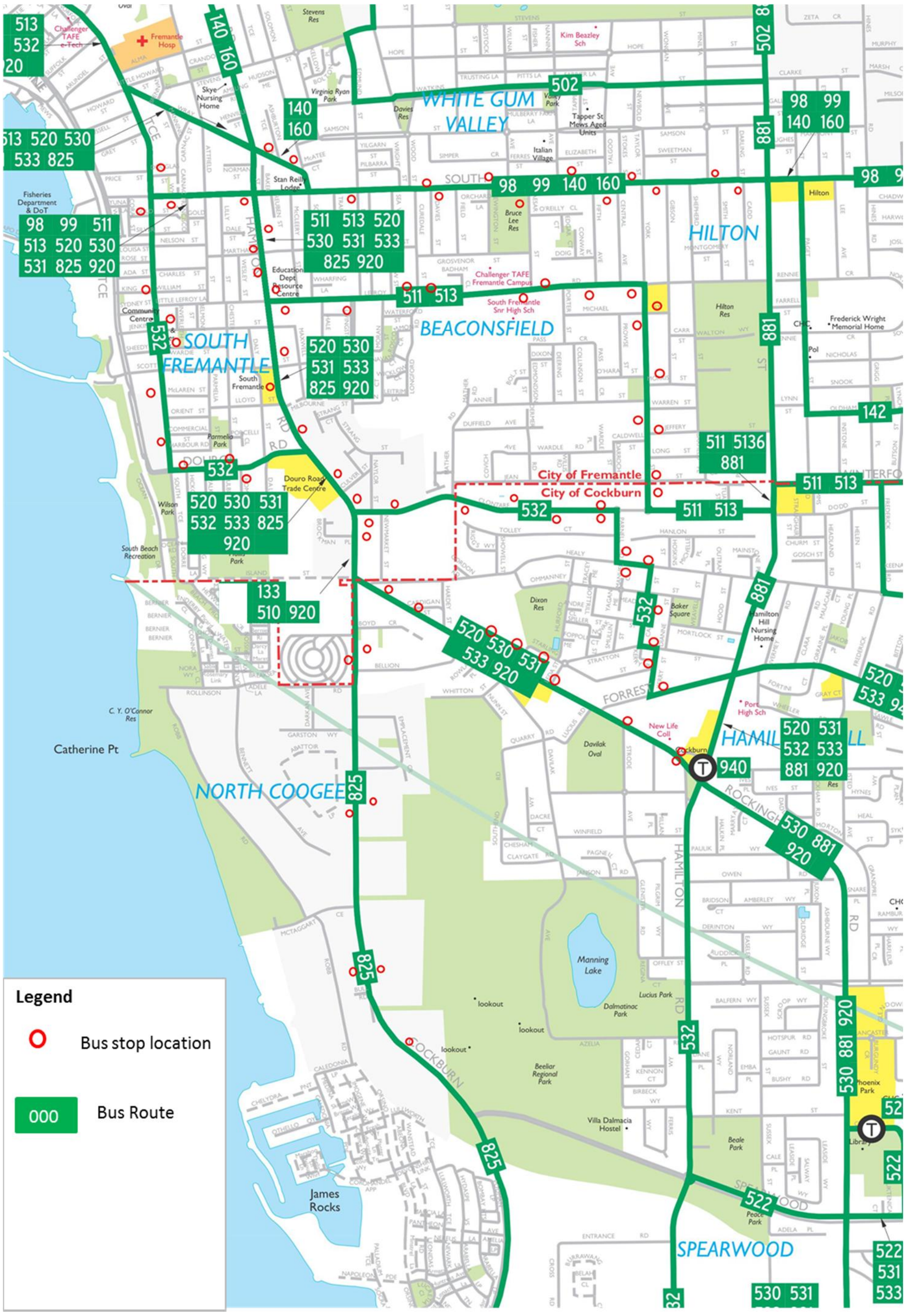

Figure 3-3 **Bus services and stops** (Source*: Transperth*)

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Table 3.1 Existing bus frequencies

Service	Route	Frequency
511	Fremantle Station - Hampton Rd - Lefroy Rd - York St - Hamilton Senior High School - Kardinya Shopping Centre – Winterfold Rd/Stock Rd. - Somerville Rd./Keall Pass	Every 15-20mins
513	Fremantle Station - Hampton Rd - Lefroy Rd - York St - Hamilton Senior High School - Kardinya Shopping Centre – Winterfold Rd/Stock Rd. - Somerville Rd./Keall Pass	Every 15-20mins
520	Fremantle Station - Hampton Rd.- Rockingham Rd./Carrington St. - Lakes shopping centre - Cockburn Central Station	Every 15-20mins
530	Fremantle Station - Hampton Rd. - Rockingham Rd./ Carrington St.- Marvell Av - Rockingham Rd. - Beeliar Dr/Durnin Av. - Emmanuel Catholic College - Cockburn Central Station	Every 15-20mins
531	Fremantle Station - Hampton Rd. - Rockingham Rd./ Carrington St.- Marvell Av - Rockingham Rd. - Beeliar Dr/Durnin Av. - Emmanuel Catholic College - Cockburn Central Station	Every 15-20mins
532	Port Pire St./Port Kembla Dr. - Fremantle Station - Hampton Rd. - Carrington St./Rockingham Rd. - Beeliar Dr/Durnin Av - Cockburn Central station	Every 15-20mins
533	Fremantle Station - Hampton Rd. - Rockingham Rd./ Carrington St.- Marvell Av - Rockingham Rd. - Beeliar Dr/Durnin Av. - Emmanuel Catholic College - Cockburn Central Station	Limited service (approx. 2 a day)
825	Fremantle Station - Hampton Rd. - Cockburn Rd. – Cockburn Rd/Magazine Ct - Rockingham Rd./Macedonia St. - Rockingham Station	Every 30-45mins
920	Fremantle Station - South St./Hampton Rd. - Rockingham Rd./Carrington St.- Kwinana Hub Bus Station - Rockingham Station	Every 15-30mins (every 10 mins in the peak)

A railway line runs through the study area operating between Cockburn and Fremantle. This line is not used for passenger travel; it is solely used for the movement of freight. According to the Network Manager at Brookfield Rail, eight freight trains per day operate on the Cockburn-Fremantle line with none currently operating in the peak periods (06:00 – 09:00 and 15:00 – 18:00). There are therefore no passenger railway services or facilities in this area.

3.4 Existing road network within and surrounding the Cockburn Coast

The existing road network is illustrated in Figure 3.4. Cockburn Road (State Route 12) is a strategic road running north-south. This route connects destinations in the south such as Coogee, the Australian Marine Complex at Henderson, the Kwinana Industrial area and Rockingham with Fremantle to the north. The route functions as the primary north – south route for freight and regional traffic. It has a speed limit of 60kph at the northern end and 70kph at the southern end with the transition point located south of the intersection with Emplacement Crescent. Robb Road provides an additional north-south link through the development site; it has a speed limit of 40kph.

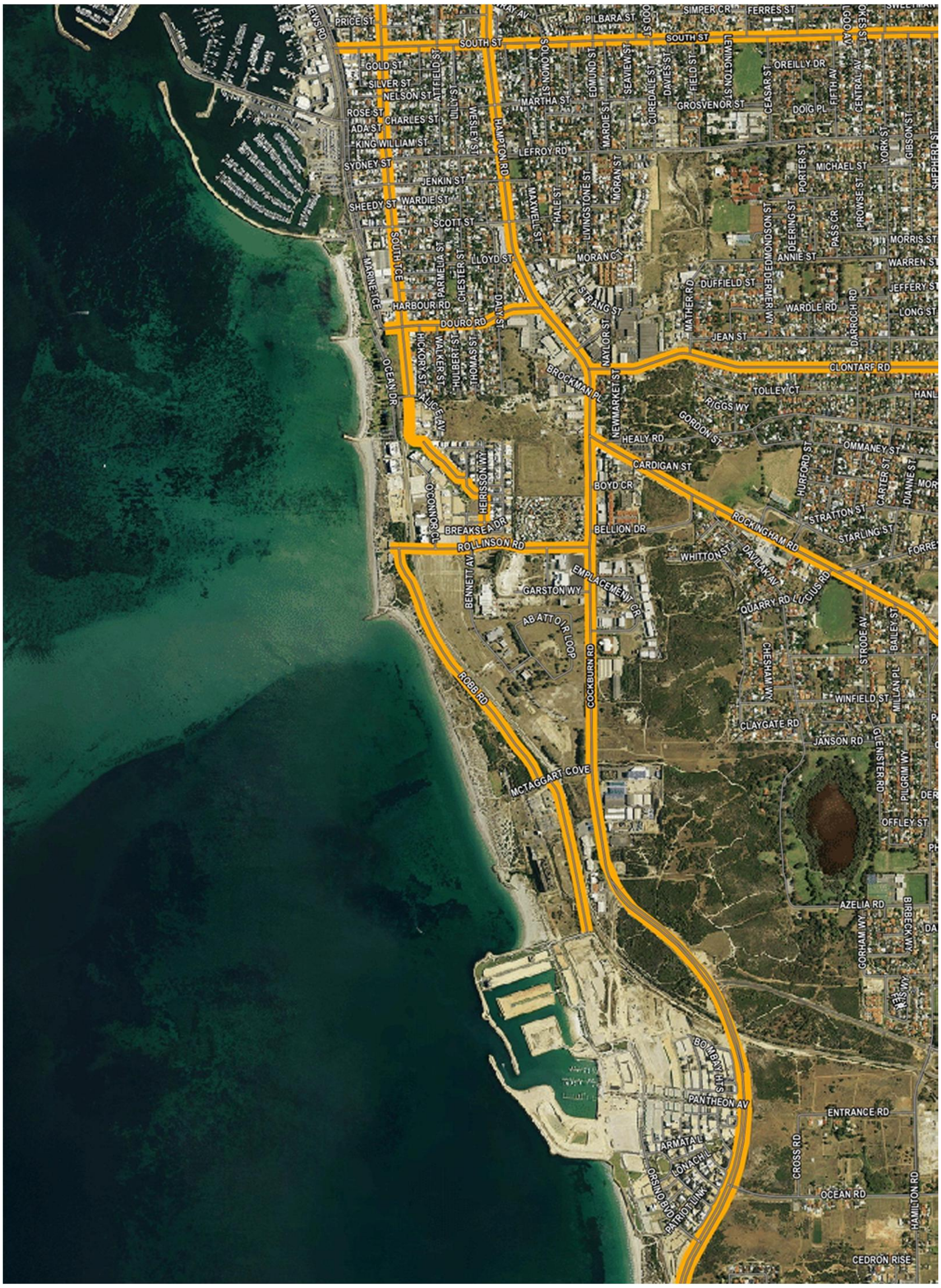

Figure 3-4 **Existing road network** *(Source: Landgate (SLIP, 2012))*

Rockingham Road is located to the north of the development area and connects Cockburn Road with Carrington Street to the east. Rockingham Road has a speed limit of 60kph. The impact of the development on the operation of the intersection of Rockingham Road and Cockburn Road will be considered as part of this Transport Assessment.

The railway line runs north to south through the development site. There are currently two locations where it is possible to cross the rail line. These are Rollinson Road and McTaggart Cove. Rollinson Road is a local road with a 50kph speed limit running east-west between Cockburn Road and Robb Road. It provides the only existing east-west access to the north of the development site. McTaggart Cove provides an east-west connection in the south. The crossing over the rail line at McTaggart Cove is shown in Photo 3.1.

Photo 3.1 McTaggart Cove rail crossing

3.5 Traffic flows on roads during the AM and PM peak hours

Base year traffic flows have been determined for links and intersections within the Cockburn Coast study area. These have been established from manual classified link and intersection counts. Automatic Traffic Counts were carried out by Austraffic between Monday 6 February and Thursday 23 February 2012. These were located at key mid-block locations in the study area. Turning counts were undertaken on Thursday 16 February and Thursday 23 February 2012 at the following intersections:

- Rollinson Road / Cockburn Road intersection
- Bellion Drive / Cockburn Road intersection
- Rockingham Road / Cockburn Road / Hampton Road intersection
- Hampton Road / Douro Road intersection
- Douro Road / Daly Street intersection
- Douro Road / South Terrace / Marine Terrace intersection
- South Street / South Terrace intersection

Further intersection counts were undertaken at the South Street / Hampton Road and the Wray Avenue / Hampton Road intersections on 21 June 2012.

SCATS data was provided by Main Roads WA for the period Monday 13 February 2012 to Sunday 26 February 2012 for a number of intersections.

The location of the data collected is shown in Figure 3.5.

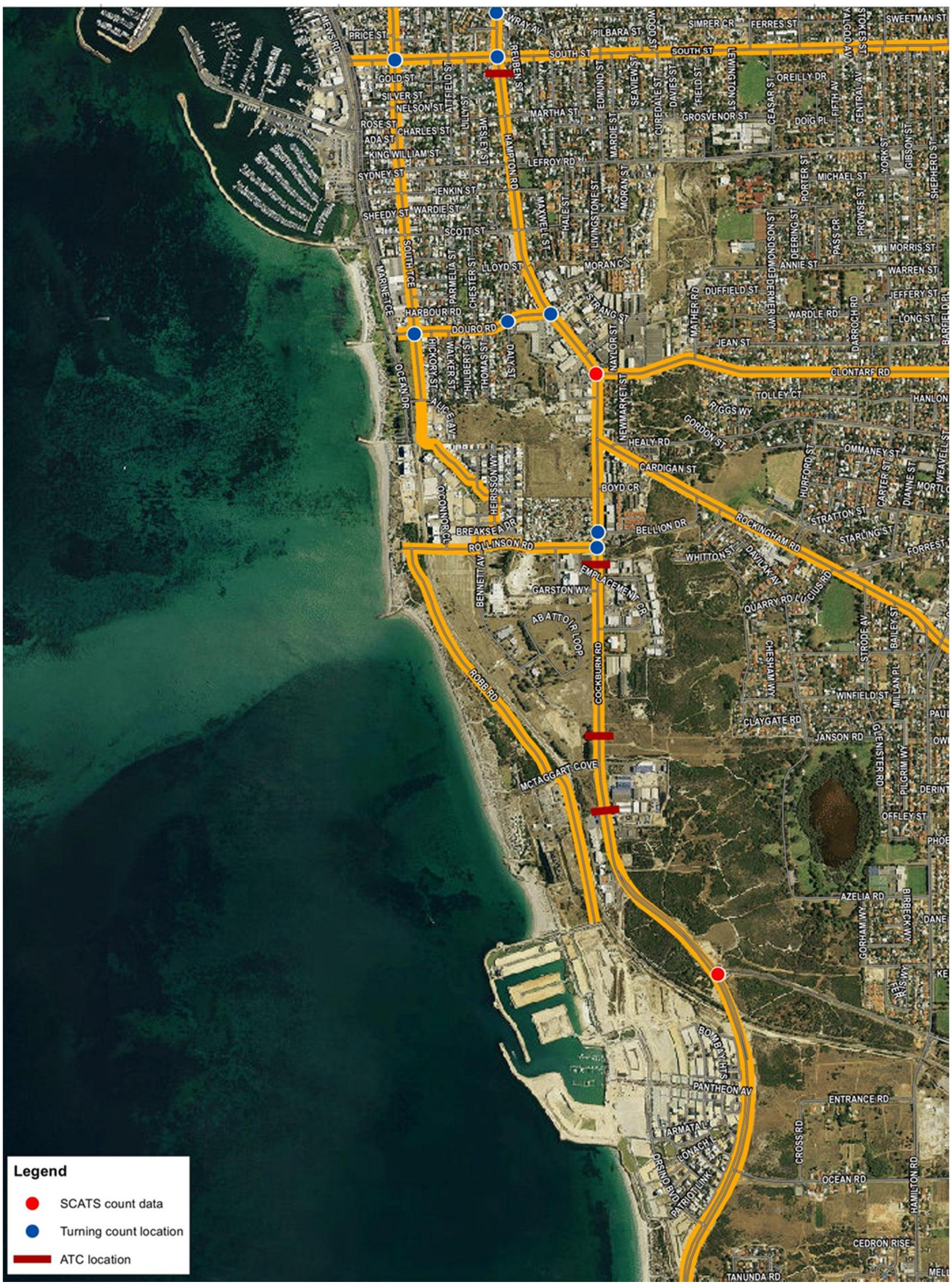

Figure 3-5 **Data collection locations** *(Source: Landgate (SLIP, 2012))*

Base year traffic flows are illustrated in Appendix A.

Signal timing charts were also sourced from Main Roads WA for the signalised intersections in the study area.

3.6 Crash data review

The Cockburn Coast Road Safety Audit (RSA) was undertaken by Parsons Brinckerhoff in January 2012. The RSA shows that in the five years up to December 2010 the section of Cockburn Road within the study area had a crash rate of 1.3 crashes per million vehicle kilometres of travel (MVKT). This compares favourably with a network average of 2.35 MVKT for a major undivided road in a built up area (Main Roads WA "Network Average Crash Rates," May 2001).

The RSA identified that there are no cycle facilities along Cockburn Road between the Rockingham Road intersection and just south of the Boyd Crescent intersection. South of Boyd Crescent to the Old Cockburn Road intersection, an un-designated narrow hard shoulder is present and is being used by cyclists. The hard shoulder varies in width and at times terminates without warning to either drivers or cyclists. South of Old Cockburn Road the road is recently constructed and includes a formal hard shoulder designated for use by cyclists. Only 1 crash in the 5 year period involved a pedestrian being hit. The crash severity on Cockburn Road is detailed in Table 3.2.

Table 3.2 Cockburn Road crash severity (2006 - 2010)

Severity	Intersections	Midblock	Total
Fatal	0	0	0
Hospital	2	3	5
Medical	5	12	17
Property damage only: Major	26	39	65
Property damage only: Minor	10	21	31
Totals	**43**	**75**	**118**

4. Proposed transport networks

4.1 Pedestrian and cycle networks and crossing facilities

As detailed in the ITP, pedestrian and cycling facilities will be provided within Cockburn Coast. Pedestrian and cyclist routes will make the site accessible for non-motorised users, whilst also helping to minimise traffic flows in the area.

The ITP recommended that priority be given to pedestrians at key street crossings and in the overall design speeds of the streets. A hierarchy for pedestrian movement has been developed to ensure safe and direct access for pedestrians throughout Cockburn Coast. The network will consist of:

- Informal tracks to the beach
- Footpaths within the road system
- Shared paths, for pedestrians and cyclists
- Shared surfaces, accommodating vehicles, cyclists, pedestrians
- Plaza spaces for pedestrians
- At grade pedestrian crossings at particular points along the freight rail alignment
- Controlled crossing points built into the road network

The proposed routes for pedestrians and cyclists are illustrated on Figure 4.1

The pedestrian and cycle network at a regional and district level will remain as it is currently.

Figure 4-1 Proposed pedestrian and cycle network for the development

There will be a number of controlled crossing points throughout the development as detailed on Figure 4.1. Signalised intersections on Rollinson Road, Main Street, McTaggart Cove, and to the south of the study area will provide crossing points for pedestrians and cyclists in the study area. Pedestrian movements will be accommodated in the proposed signal timings. Two pedestrian activated crossings will also be provided in the southern part of the study area.

Secure and convenient cycle parking will be provided. This will be located within or adjacent to buildings with fully secure cycle lock-up facilities in overlooked locations. This will provide added security and user safety.

Pedestrian crossings across the railway line will be provided in a number of locations. There will be at-grade crossing facilities for both pedestrians and vehicles on Rollinson Road and Main Street. A crossing point will also be provided further south within the Power Station Precinct.

The Cockburn Coast development will be a shared space designed with slow speeds in mind as illustrated on Figure 4.2. The majority of shared streets will be provided in the Robb Jetty precinct, although some will also be provided in the Hill Top / Emplacement and Power Station precincts.

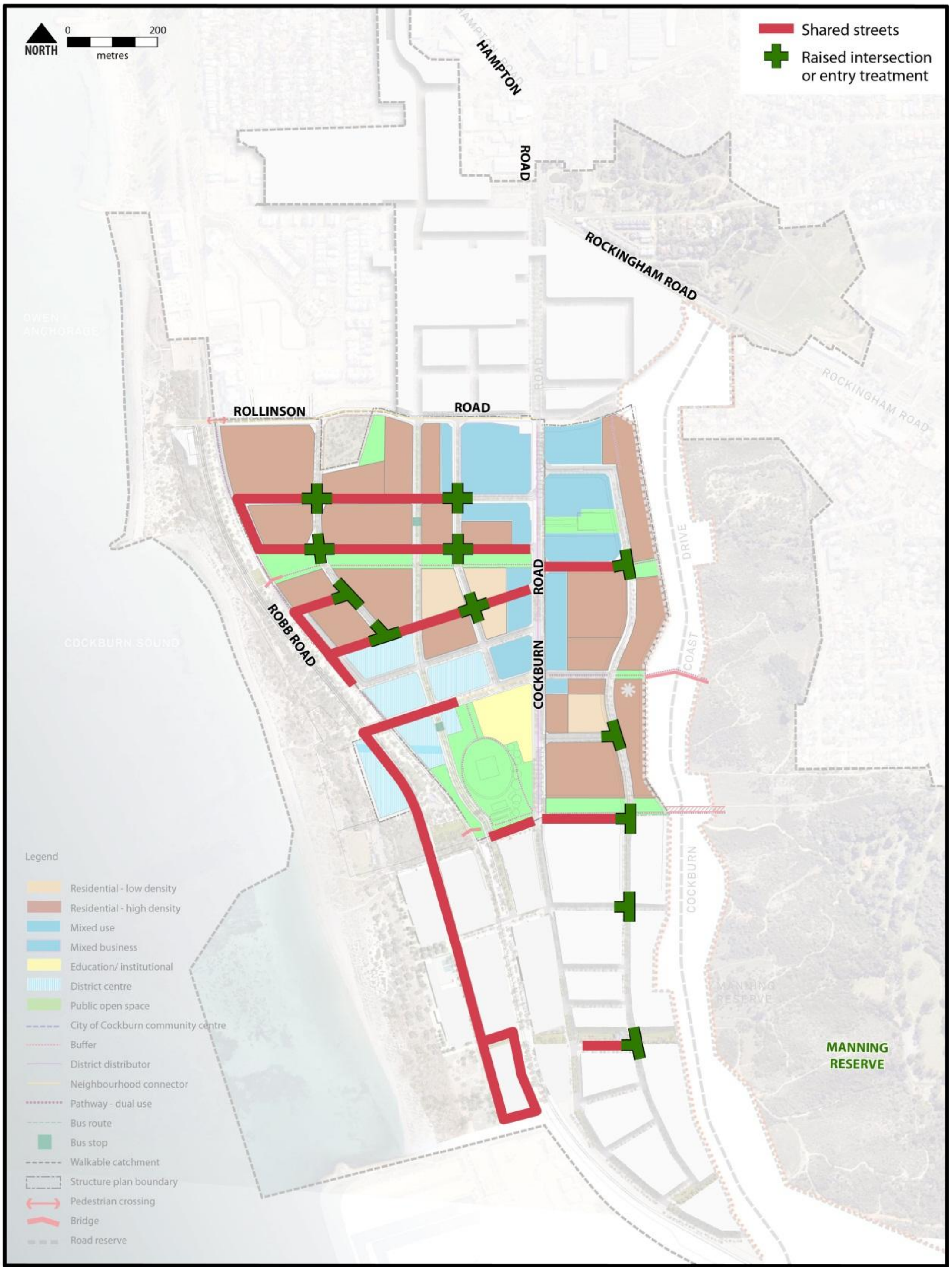

Figure 4-2 Proposed shared streets

Shared zones are proposed on Main Street and a number of east-west streets. These will form an east-west greenway linking the coast and Manning Reserve. Shared surfaces will also be provided on a number of north-south links through the development including Robb Road. These links will form part of a coastal greenway connecting the existing Principal Shared Pathway network to the north and south of Cockburn Coast.

4.2 Public transport routes

A Bus Rapid Transit (BRT) corridor will be created along Cockburn Road and through the site, connecting Fremantle to Rockingham. Figure 4.3 shows the proposed route and associated bus stops.

The BRT will help to encourage public transport use within Cockburn Coast and will reduce the reliance on private car travel.

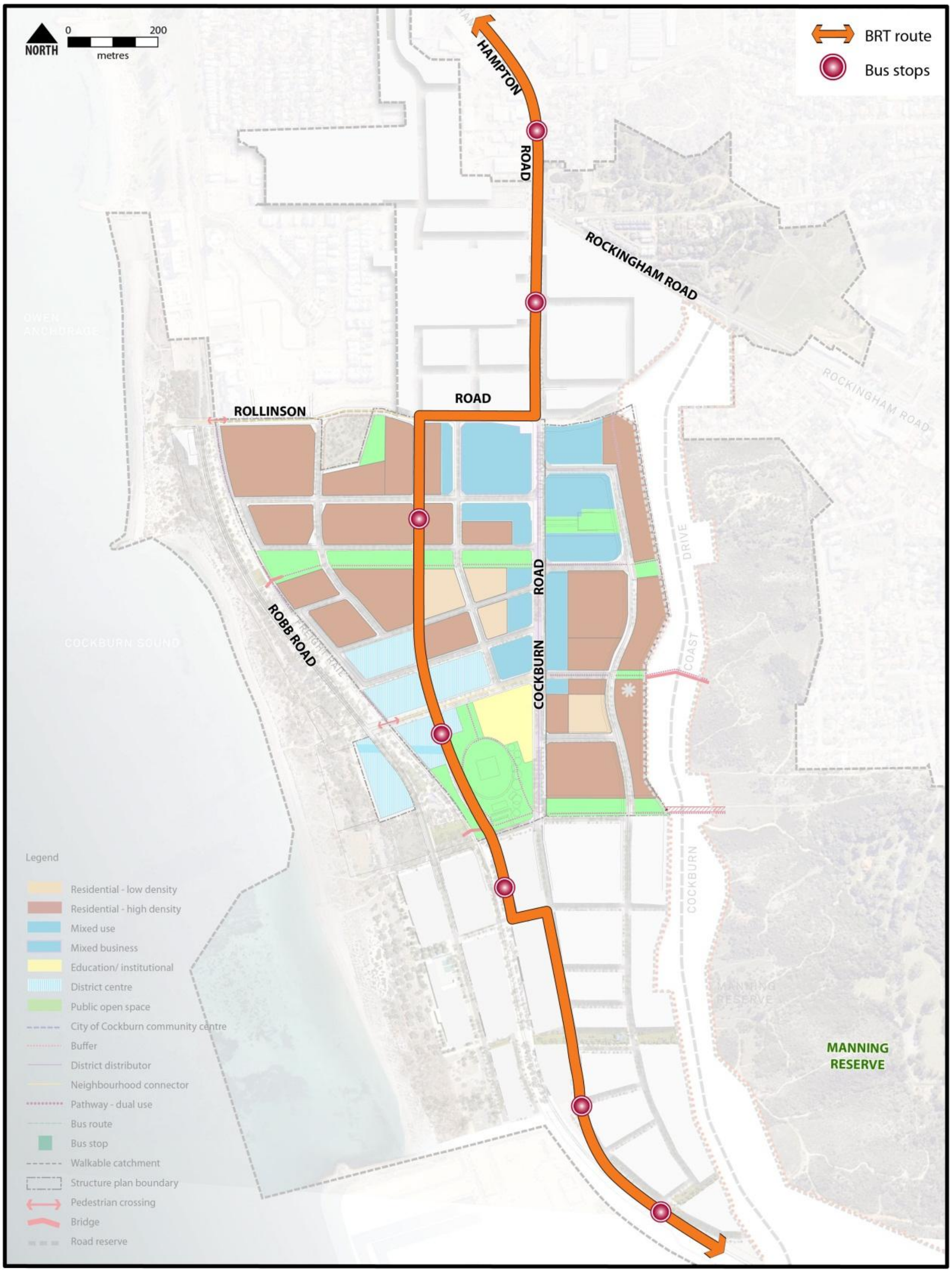

Figure 4-3 Proposed BRT route

The BRT stops are located approximately every 400-600 metres and will therefore be within walking distance for the majority of the development.

The local, district and regional services that currently operate in the study area will remain.

4.3 Changes to existing road network

Figure 4.4 shows the proposed road network layout in the study area. A number of routes will be constructed through the development, providing both north-south and east-west links through the site. These routes will provide access to and from the development itself.

Figure 4-4 Proposed road network

There are three key types of road throughout the development. These are local streets, main streets (key routes into and out of the development) and regional routes (Cockburn Road).

Of these different road types some will have a shared surface and some will need to accommodate the BRT. Figure 4.5 illustrates the proposed road hierarchy of streets throughout the development.

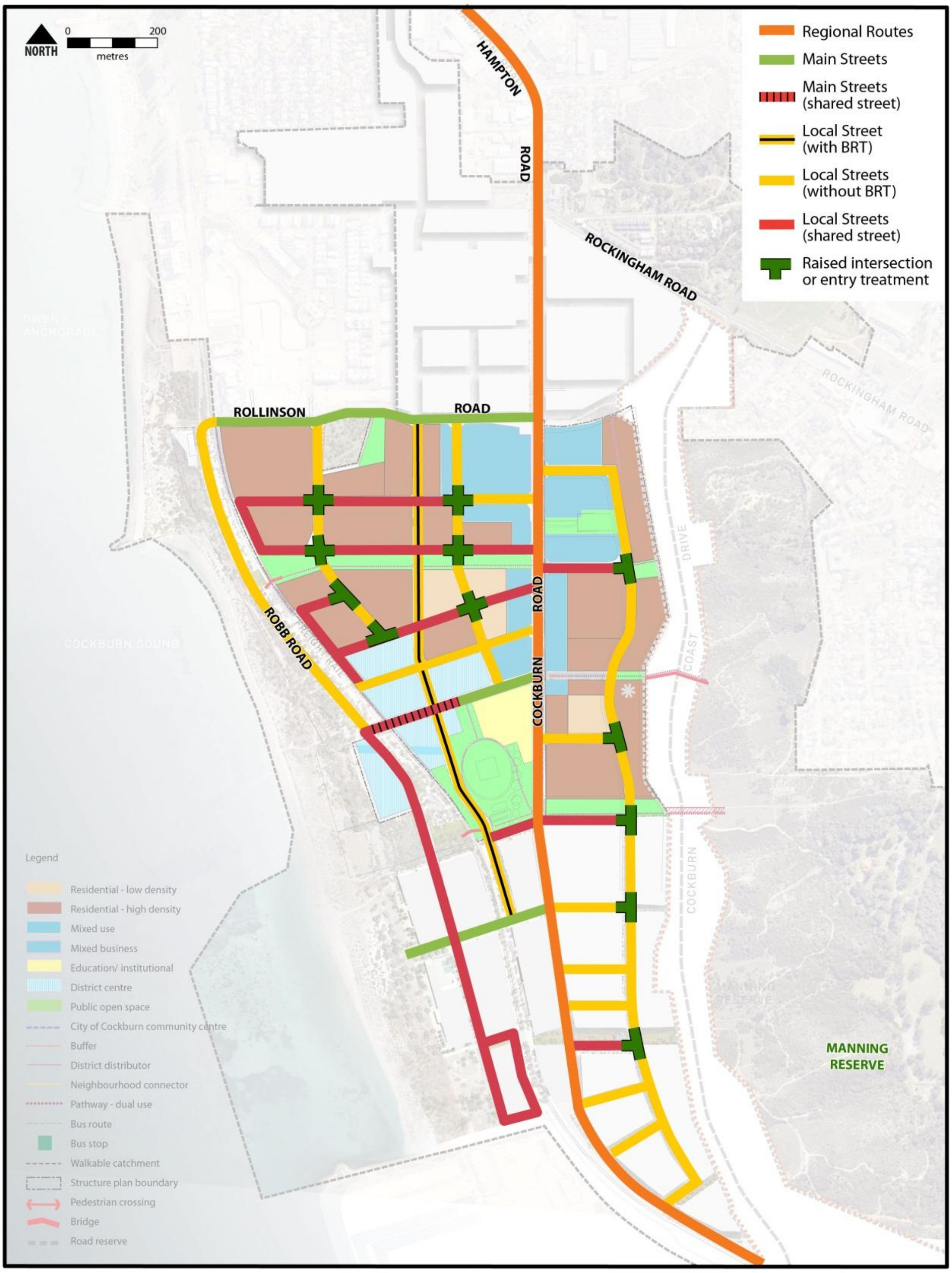

Figure 4-5 Proposed Road Hierarchy for the development

Figure 4.6 and Figure 4.7 show possible road cross sections for Main Street for the sections with and without shared surfaces. The same cross section would be expected for the other key routes into the development such as Rollinson Road and McTaggart Cove.

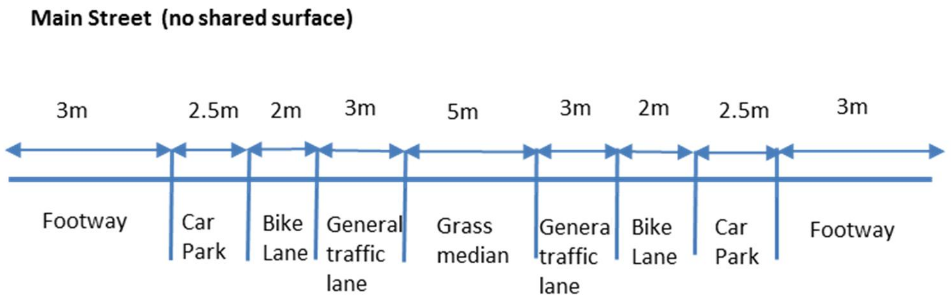

Figure 4-6 Cross section for Main Street assuming no shared surface

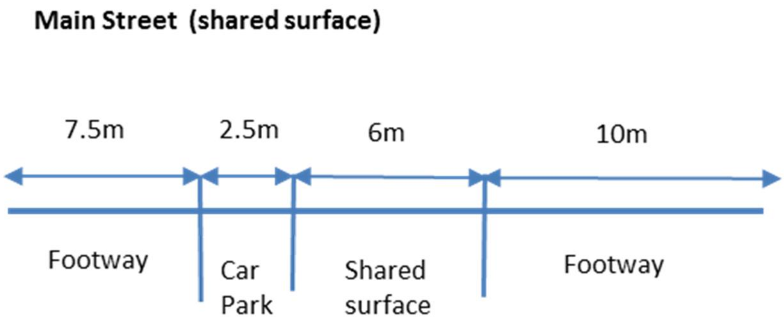

Figure 4-7 Cross section for Main Street for the shared surface section

As Main Street is one of the key routes into the Robb Jetty precinct, the road will need to accommodate slightly higher traffic volumes than other internal roads. The road cross section therefore needs to be designed in a different way to the local roads within the development. Figure 4.8, Figure 4.9 and Figure 4.10 show possible cross sections for a local road within the development. Some local roads will have shared zones whilst others will need to be able to accommodate the BRT.

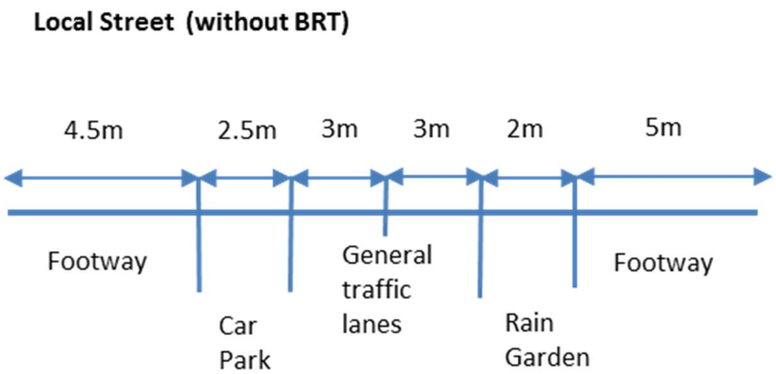

Figure 4-8 Cross section for a local street (without the BRT)

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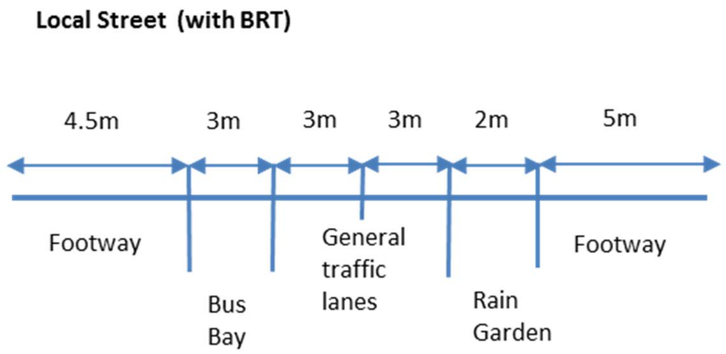

Figure 4-9 Cross section for a local street (with the BRT)

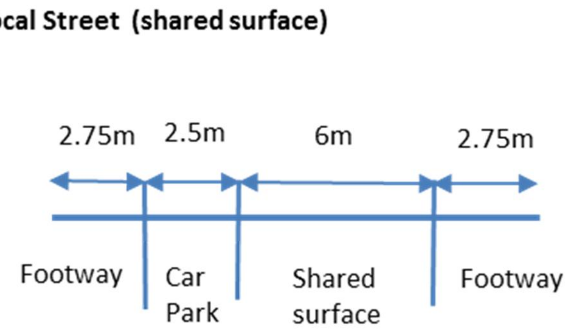

Figure 4-10 Cross section for a local street (with a shared surface)

Cockburn Road will perform both a local and regional traffic function and therefore will be widened to include two lanes in each direction from Rockingham Road through to Spearwood Avenue. A median will be introduced along Cockburn Road. A typical cross section for Cockburn Road is illustrated on Figure 4.11. Although Cockburn Road will continue to perform a local and regional traffic function, the speed limit will be reduced to 50kph providing a route that is also suitable for cycling and walking.

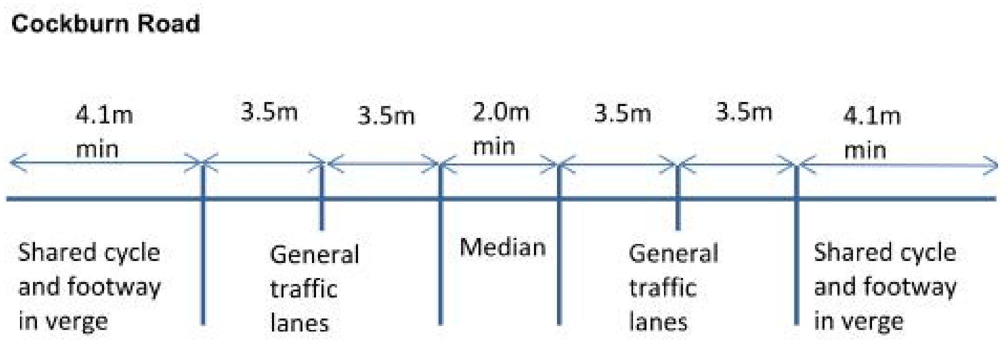

Figure 4-11 Typical Cross section for Cockburn Road

Along Cockburn Road, the Rollinson Road intersection will be upgraded to a signalised intersection and signals will also be introduced at the Main Street / Cockburn Road and McTaggart Cove / Cockburn Road intersections.

This report assumes that Cockburn Coast Drive is not in place as this project is currently unfunded and its timing is uncertain. For information Cockburn Coast Drive is shown on Figure 4.4 as a potential future regional road.

No change is proposed at either intersection of Emplacement Crescent with Cockburn Road. The northern intersection will continue to be restricted to Left in / Left out only. The southern intersection will remain as an all movements uncontrolled intersection.

McTaggart Cove will be relocated further south. The level crossing currently situated on McTaggart Cove will however be relocated to Main Street. This will provide a link through the development to Robb Road and the beach. A new level crossing (likely to be grade separated) will be constructed to provide a rail crossing point to the south of the development within the Power Station Precinct.

Figure 4.12 shows the proposed speed limits within the study area. Speed limits have intentionally been kept low within the development to create an environment that encourages and enables safe walking and cycling. The internal roads will have speed limits of 30kph and 10kph. As previously detailed the speed on Cockburn Road will be reduced to 50kph, again to encourage non-motorised modes of travel within the area.

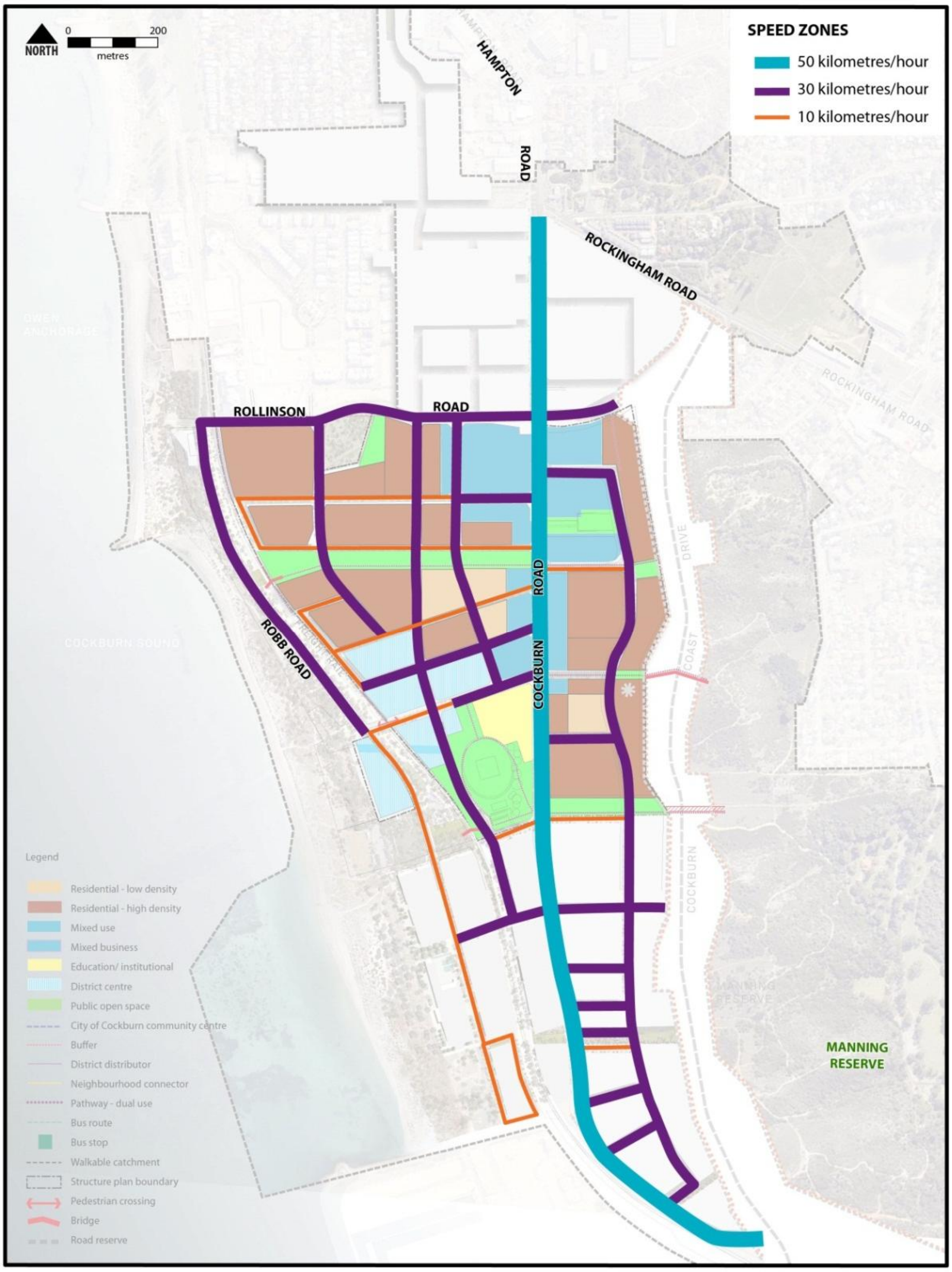

Figure 4-12 Proposed speed limits in the study area

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5. Integration with surrounding area

5.1 Surrounding attractors / generators

Figure 5.1 indicates the development site and a perimeter 800 metres from the boundary of the Cockburn Coast structure plan area. Figure 5.1 illustrates the key attractors and generators within this perimeter.

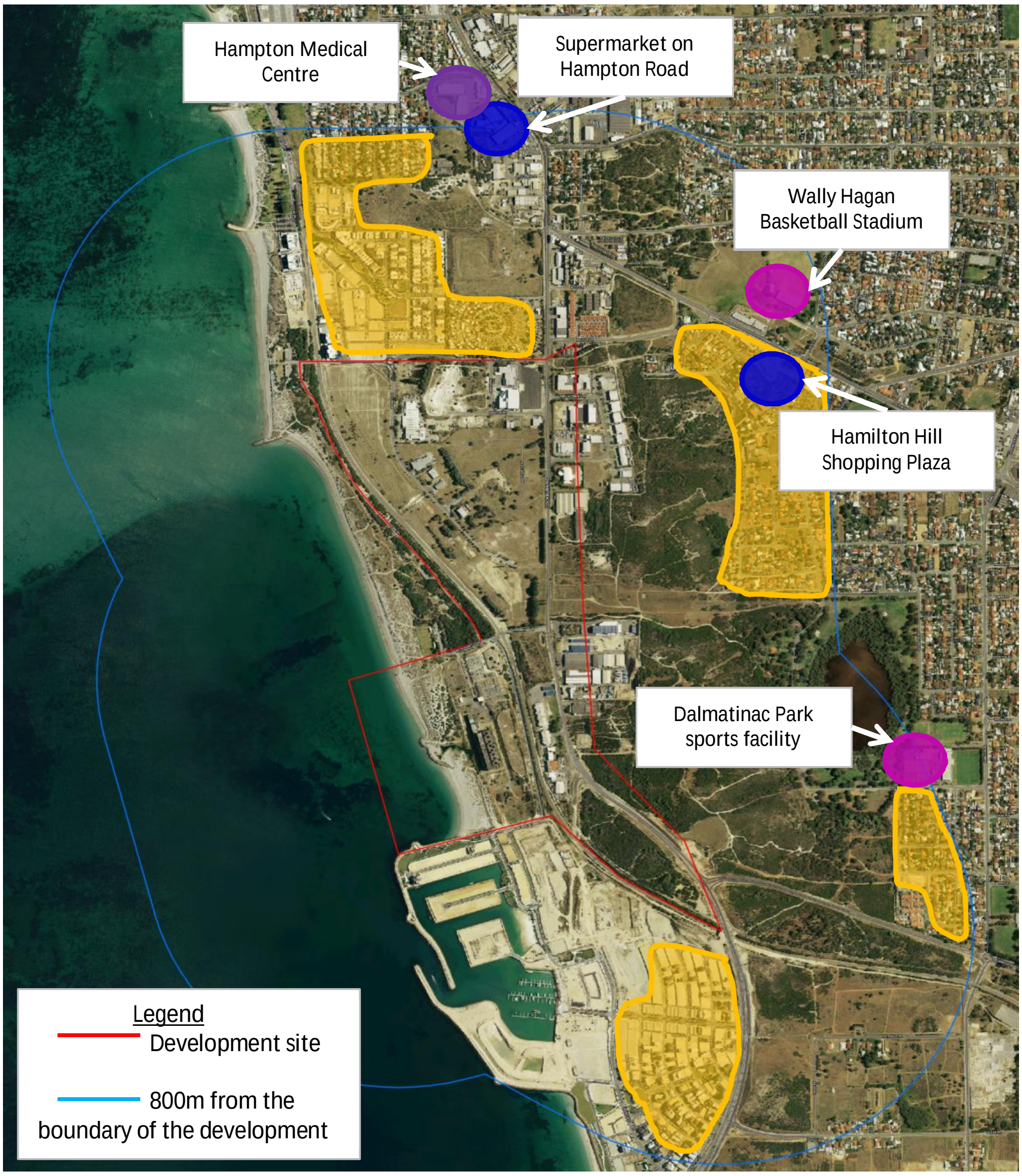


Figure 5-1 Key attractors and generators

There are a number of residential areas within the 800m perimeter that would be classed as major generators. These include the residential area to the north of Rollinson Road, the area to the east of Emplacement Crescent around Davilak Avenue, the area to the south east around Gorham Way and the area to the south around Pantheon Avenue. People from these residential areas would be attracted to land uses within Cockburn Coast such as the activity centres, the community and commercial land use and the mixed use development. There is potential that people from these areas could travel to the primary school proposed within the

Robb Jetty precinct, however it is likely that existing schools located outside the 800m perimeter would serve these existing residential developments.

Within the perimeter there are also a number of attractors that would attract people from within Cockburn Coast. There is a shopping plaza at Hamilton Hill on Rockingham Road which includes a grocery store, fast food outlets and other small retail outlets. There is also a supermarket on Hampton Road within the 800m perimeter. A number of sports and recreation facilities are located within the perimeter. The Wally Hagan Basketball Stadium is located on Starling Street off Rockingham Road, whilst Dalmatinac Park sports facility is located on the perimeter on Azelia Road. These would potentially attract residents of the Cockburn Coast development. The Hampton Medical Centre is located just outside the 800m perimeter, however this could potentially be a major attractor for people within the development, although medical facilities will be provided within the development itself.

5.2 Proposed changes to surrounding land uses

No other major changes are proposed within the 800 metre perimeter.

5.3 Travel desire lines from Cockburn Coast to these attractors / generators

The travel desire lines between each of the attractors and generators are illustrated on Figure 5.2. This illustrates east-west and north-south movements to and from the development.

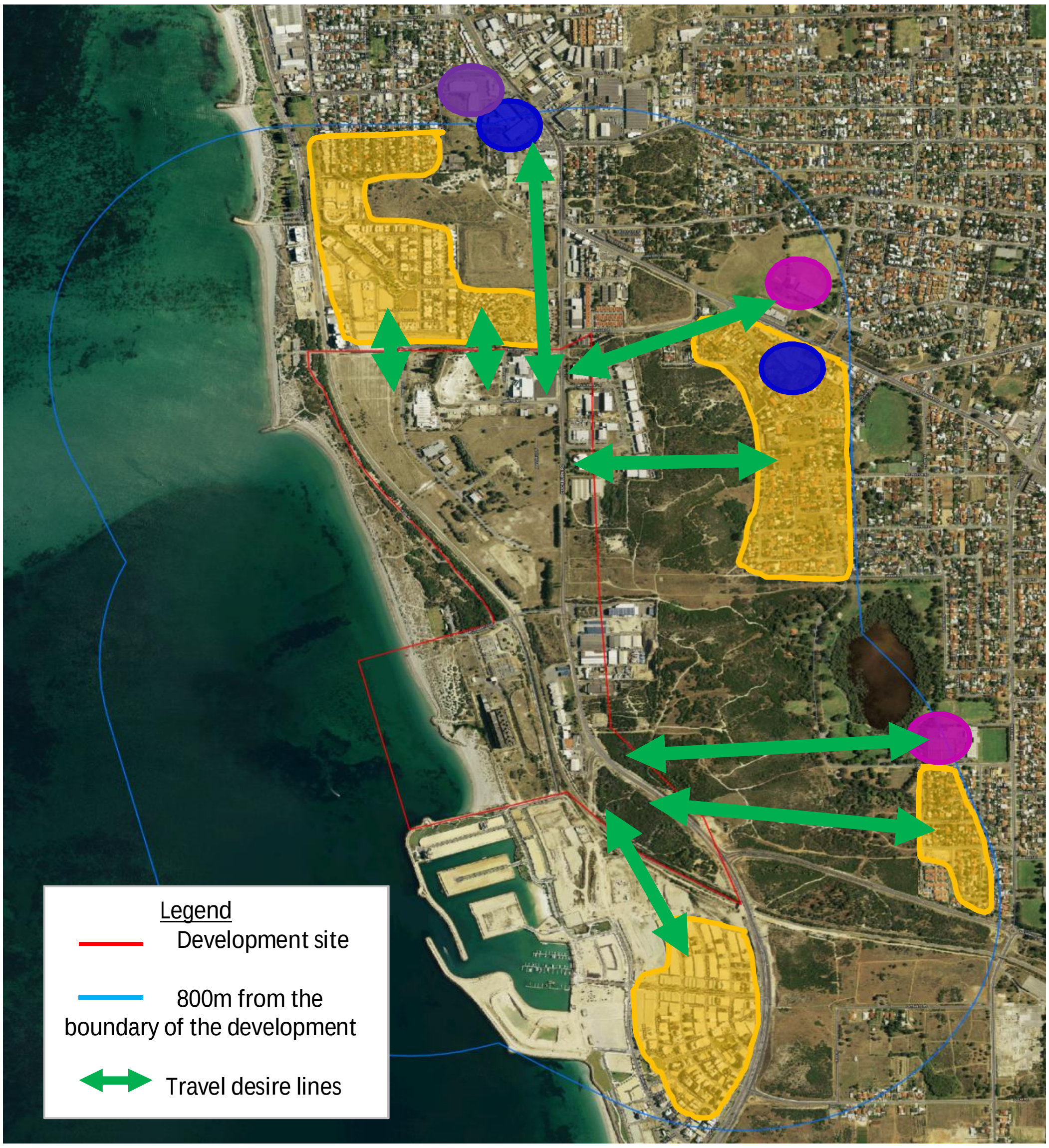


Figure 5-2 Travel desire lines

5.4 Adequacy of existing transport networks to match the desire lines and remedial measures to address any deficiencies

The existing transport network allows for east-west movements on the road network via Rockingham Road and Spearwood Avenue. Off road routes are currently provided for pedestrians and cyclists from Cockburn Road eastwards through the Manning Reserve to the developments in the east. There are currently only a small number of crossing points on Cockburn Road connecting these links to the development however, primarily at the signals at the Rockingham Road intersection.

As part of the Cockburn Coast development, signalised intersections are proposed at Rollinson Road, McTaggart Cove and Main Street. These will provide potential crossing points for pedestrians and cyclists, improving the connections between Cockburn Coast and the areas to the east. Two pedestrian crossing points will also be provided along Cockburn Road, further enhancing the connectivity of the development and adequately matching the desire lines. The location of the crossings will allow for more direct access for pedestrians and cyclists.

With regards to the existing north-south transport network, there are currently no cycle facilities along Cockburn Road between Rockingham Road and just south of Boyd Crescent. The road safety audit identified that there is an undesignated narrow hard shoulder that is being used by cyclists south of Boyd Crescent to Old Cockburn Road. Ultimately, Cockburn Coast will create a number of potential north-south routes. These will provide high quality routes for pedestrians and cyclists through the development, also connecting the development to the areas in the north and south. These routes will be in the form of shared paths providing an attractive route for non-motorised modes of travel. The BRT will provide an additional north-south connection through the area.

6. Analysis of transport networks: traffic assessment

6.1 Introduction

The WAPC Transport Assessment Guidelines for Developments outlines the need to provide a quantitative analysis of the proposed internal and external transport networks to demonstrate that they will provide a high level of accessibility and safety for all modes. To aid this assessment, a SATURN traffic assignment model has been developed for the Cockburn Coast study area. This allows for the estimation of traffic flows in the future, both with and without Cockburn Coast, taking into account how motorists may travel within the study area.

In order to assess the traffic impact in the future, a best practice approach of developing a model to represent the current situation was produced (a base year model). Developing a base model which replicates current travel movements to a good level of detail provides confidence that results from the future year models (which are built from it) used to conduct the traffic assessment are robust. Once the base model had been developed, future year models representing two scenarios were built. These represent a Do Minimum scenario (a model without the Cockburn Coast proposals) and a Do Something model (a model with the Cockburn Coast proposals). Both of these were forecast to represent traffic movements in 2031. The traffic assessment then considers the difference in network operation between the Do Minimum and Do Something scenarios to determine the impacts of the Cockburn Coast development.

The methodology used to develop the base and future year models and to determine the traffic flows in the Do Minimum (without Cockburn Coast) and Do Something (with Cockburn Coast) scenarios are outlined in the following paragraphs.

6.2 Assessment years

An assessment year of 2031 has been chosen as this is the year of practical completion for the development. This future year is also considered in the ITP and also ties in with forecasts from the Department of Planning's Strategic Transport Evaluation Model (STEM). This is important as STEM has been used to initially estimate the distribution of trips in both the base year and future year and also to inform traffic growth in the future other than that contributed to by the Cockburn Coast development. This will be discussed in more detail in subsequent paragraphs.

6.3 Time periods for assessment

Two time periods have been modelled. These are an average weekday AM Peak hour (0700 – 0800) and PM Peak hour (1600 – 1700). These hours have been chosen to be modelled as the traffic counts indicated a peak in traffic volumes and therefore represent the traffic volumes most critical to the operation of the surrounding network.

6.4 Base year model development

Methodology

A base year model has been developed for 2012 using the SATURN software package. Figure 6.1 illustrates the process undertaken to develop the base year model.

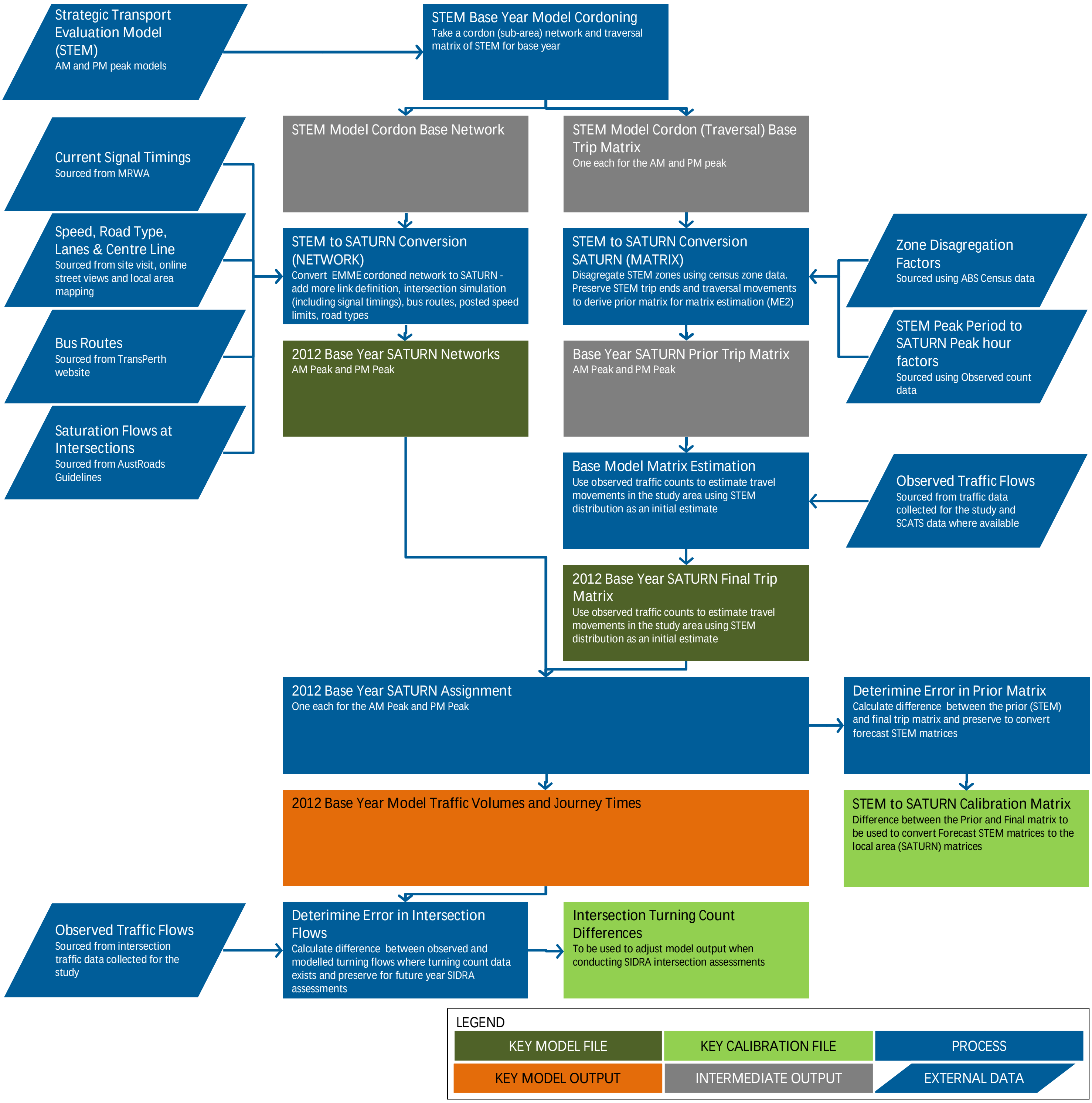


Figure 6-1 Flow diagram illustrating the process to develop the base year SATURN model

Study area and zone system

A local road network has been built to consider movements around the study area. The network covers the study area as detailed in Figure 1.2. Trip volumes to areas further afield are indirectly accounted for in the model as trip movements through the study area have been informed from STEM. However, highway network beyond the study area has not been explicitly modelled in SATURN.

The study area has been divided into a number of zones within the model. The zone system assumed in STEM was used as a starting point. The study area in STEM is however represented by a relatively small number of zones covering reasonably large areas. As it is necessary within this assessment to consider trip movements in detail within the study area, it was decided that the larger zones be split into a series of smaller zones. This was done based on area statistics extracted from the 2006 Census via the ABS website.

Vehicle classes

The model has been developed assuming two user classes, one each for light and heavy vehicles. Bus services in the area have been represented in the model as ‘fixed flows’, whilst the BRT movements have been added manually.

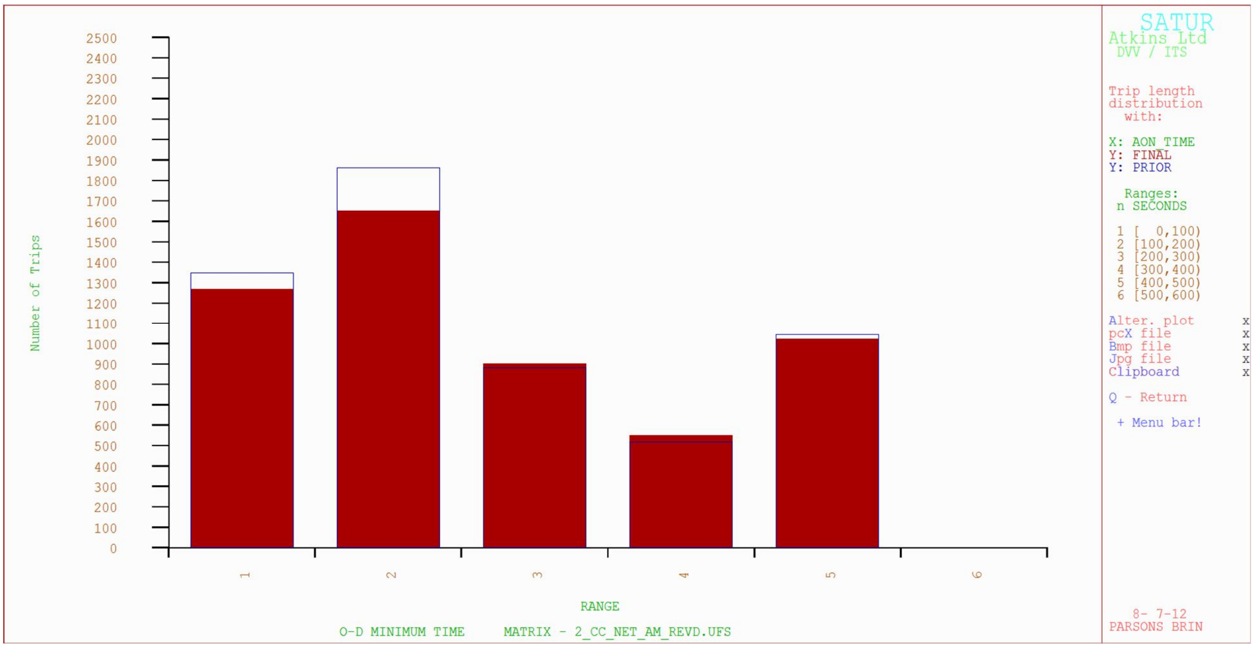
Signal timing

Signal phase plans and actual signal timings in operation at signalised intersections in the study area were sourced from Main Roads WA. The signal plans and timings shown as operating in each peak hour were incorporated into the network coding for the base year model.

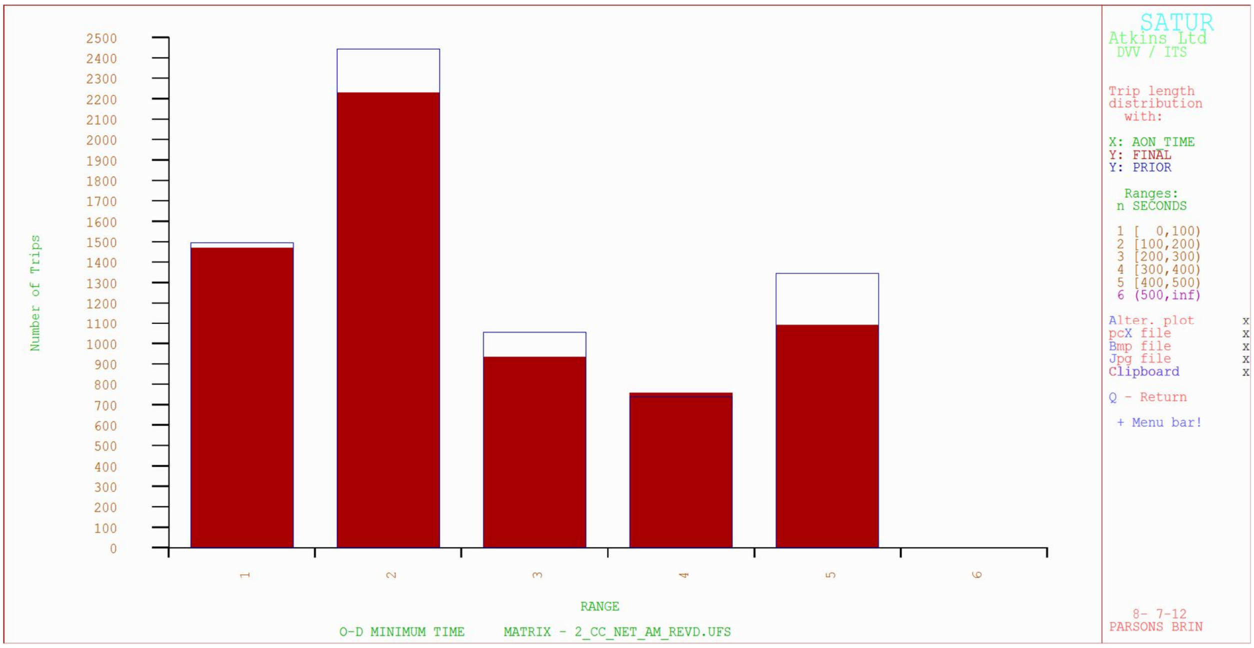
Matrix formation

The matrix was cordoned out of STEM and the trips within the STEM matrix retained. This formed what is known as a prior matrix (the best estimate of trip distribution using available data sources). Matrix estimation (using the SATURN ME2 module) has then been used to estimate a more accurate trip matrix which matches more closely with observed traffic flows. The ME2 process was carried out for the light vehicle user class, limited to a maximum of two iterations to avoid any excessive distortion to the model.

If used incorrectly, ME2 can significantly distort the trip distribution between the prior and final trip matrices. One common issue is that ME2 can significantly shorten the trip length distribution of trips in a model in its attempt to match origin / destination movements to observed traffic counts. It is therefore important to compare trip lengths before and after ME2 has run in order to ensure trip lengths have not changed significantly. Graph 6 1 and Graph 6.2 illustrate the trip length distributions for the morning and evening peak hours.



Graph 6.1 Comparison of AM peak hour trip length distribution

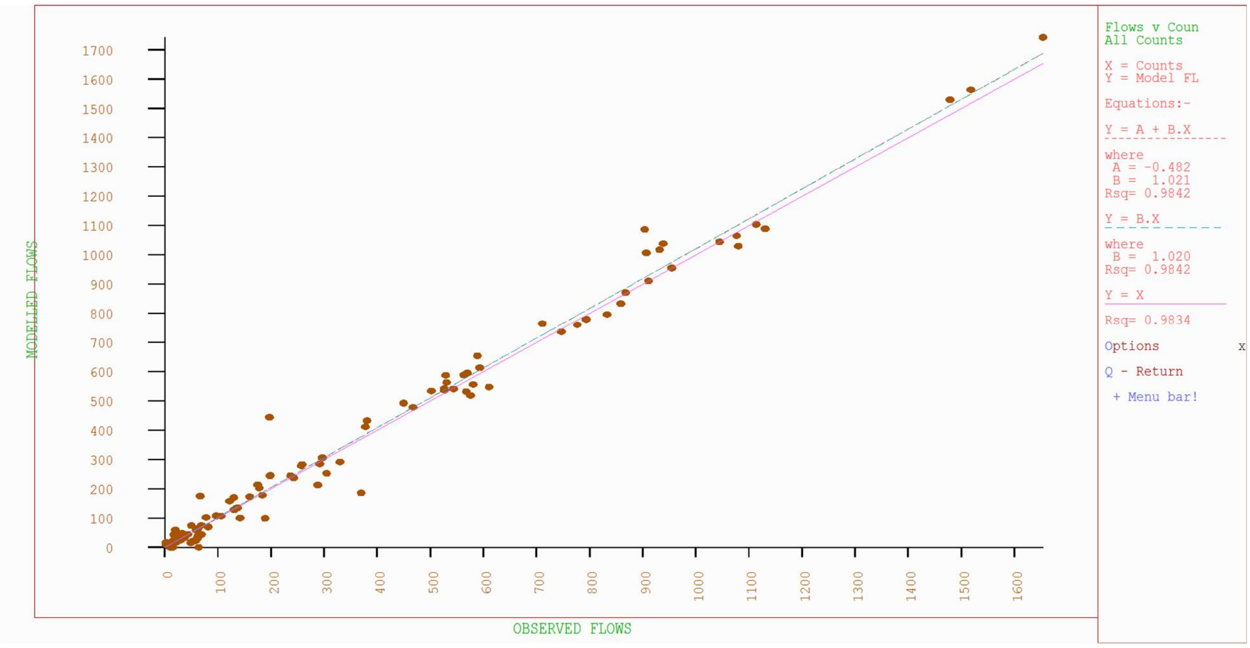


Graph 6.2 Comparison of PM peak hour trip length distribution

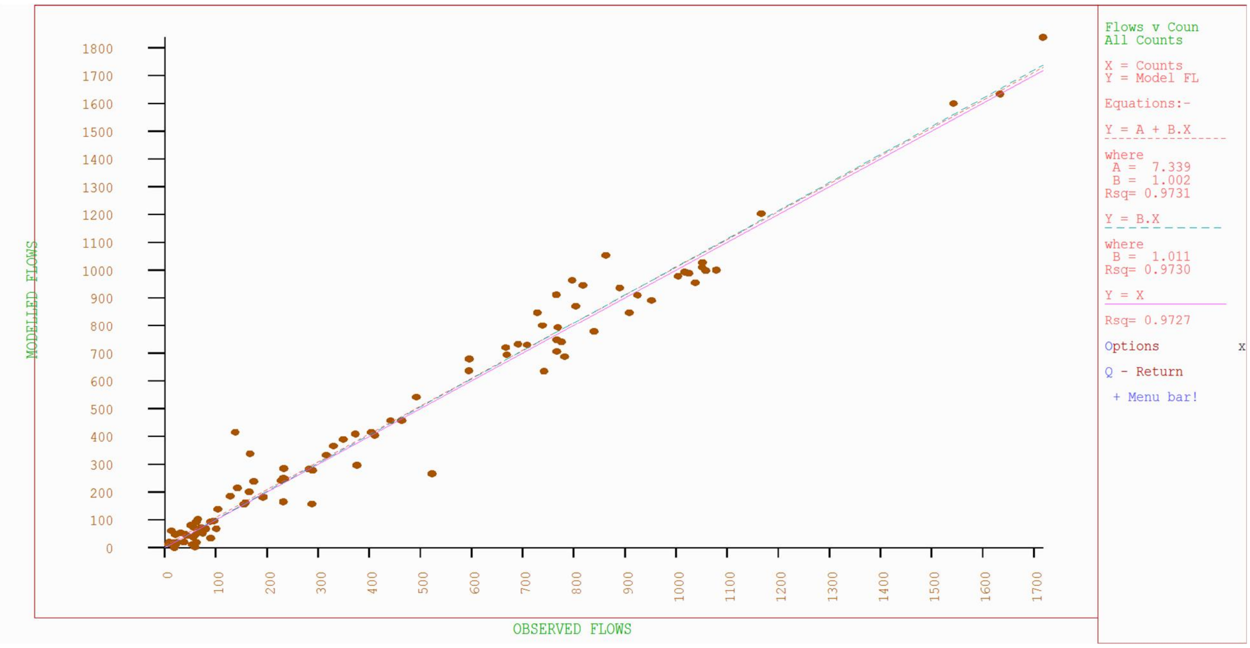
The graphs show that the trip length distribution between the prior matrix (blue bars) and the final trip matrix in both peaks are very similar. In a number of cases, the final trip matrix totals lie beneath the prior matrix totals implying an overestimate of trip levels input to the ME2 process for those cost bins. The graphs however, show that the ME2 process has not increased the number of short distance trips which can be a commonly incurred issue if the process is not run correctly.

Model calibration

Due to the small size of the study area, the limited number of parallel routes (i.e. a low level of route choice in the model) and the amount of traffic count data which was available; all the available traffic counts were used to calibrate the model in the ME2 process. To assess how well the model replicates observed traffic flows, scatter plots of observed versus modelled flows can be produced. In a model which perfectly represents observed traffic flows, data points would appear on a 45 degree angle line (known as a y=x line) and be perfectly correlated (R2=1). Scatter plots for the SATURN model produced here can be seen in Graph 6.3 and Graph 6.4 below.



Graph 6.3 Comparison of AM peak hour observed vs modelled flow plot



Graph 6.4 Comparison of PM peak hour observed vs modelled flow plot

The calibration results shown in Graph 6.3 and Graph 6.4 demonstrate that the model is replicating observed traffic flows to an excellent level of accuracy. The model is therefore considered sufficiently accurate and robust for forecast purposes.

6.5 'Do minimum' scenario (without Cockburn Coast)

Figure 6.2 illustrates the process undertaken to develop the Do Minimum model.

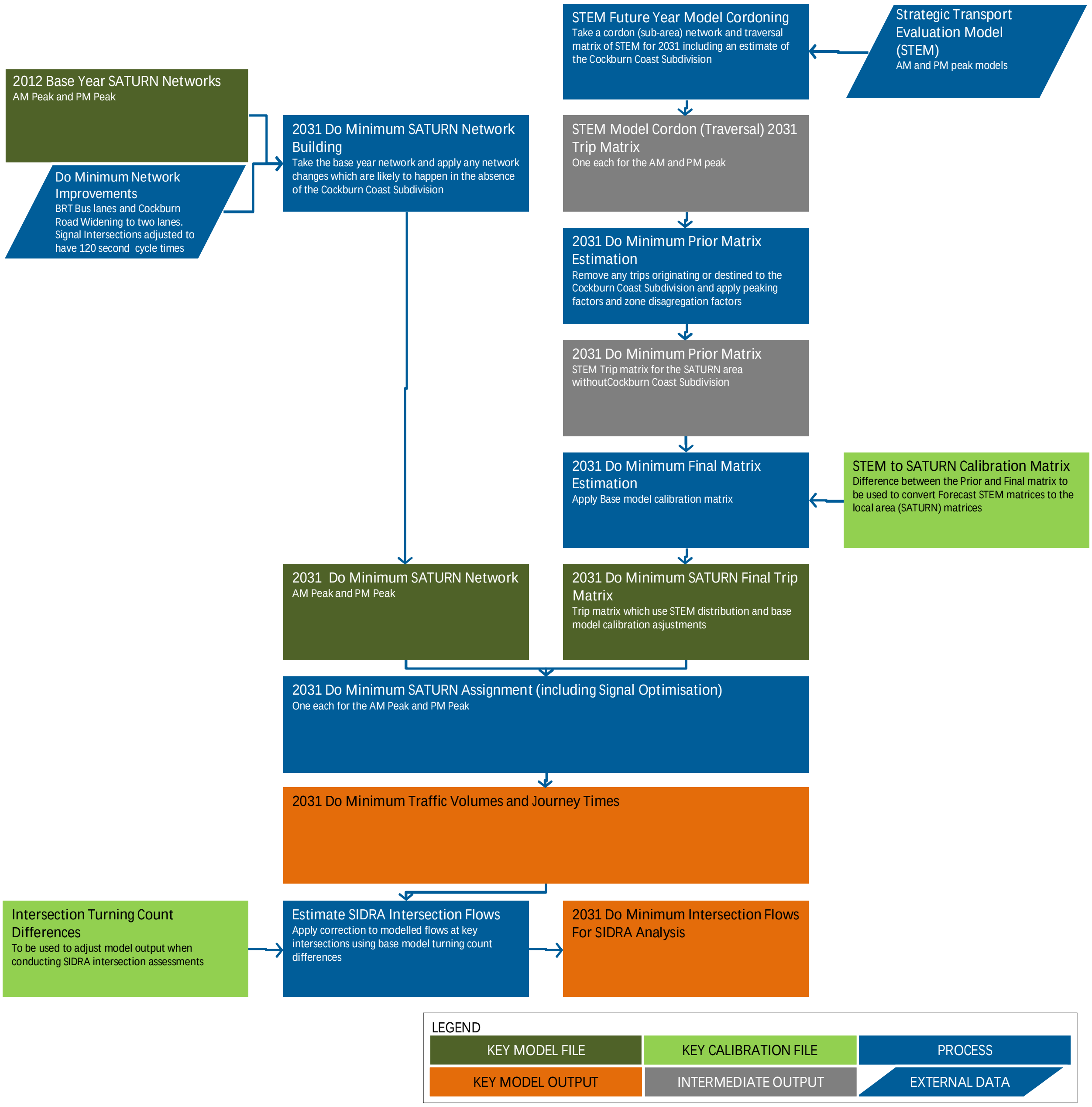


Figure 6-2 Flow diagram illustrating the process to develop the Do Minimum SATURN model

STEM has been used to provide an appropriate distribution of trips in the future year and to inform the background traffic growth which may result due to transport schemes and developments located outside the SATURN study area. STEM outputs from the 2031 model formed the prior matrix for 2031 for this study. Again the zone system was broken down into an increased number of zones in the study area. The difference between the base year prior and final matrices was calculated and this difference was applied to the 2031 prior matrix to form the Do Minimum (without Cockburn Coast) trip matrix.

The Do Minimum network includes BRT intersection layouts north of Rollinson Road and includes two lanes in each a northbound and southbound direction between Rockingham Road and Spearwood Avenue.

6.6 'Do something' scenario (with Cockburn Coast)

Figure 6.3 illustrates the process undertaken to develop the Do Something model.

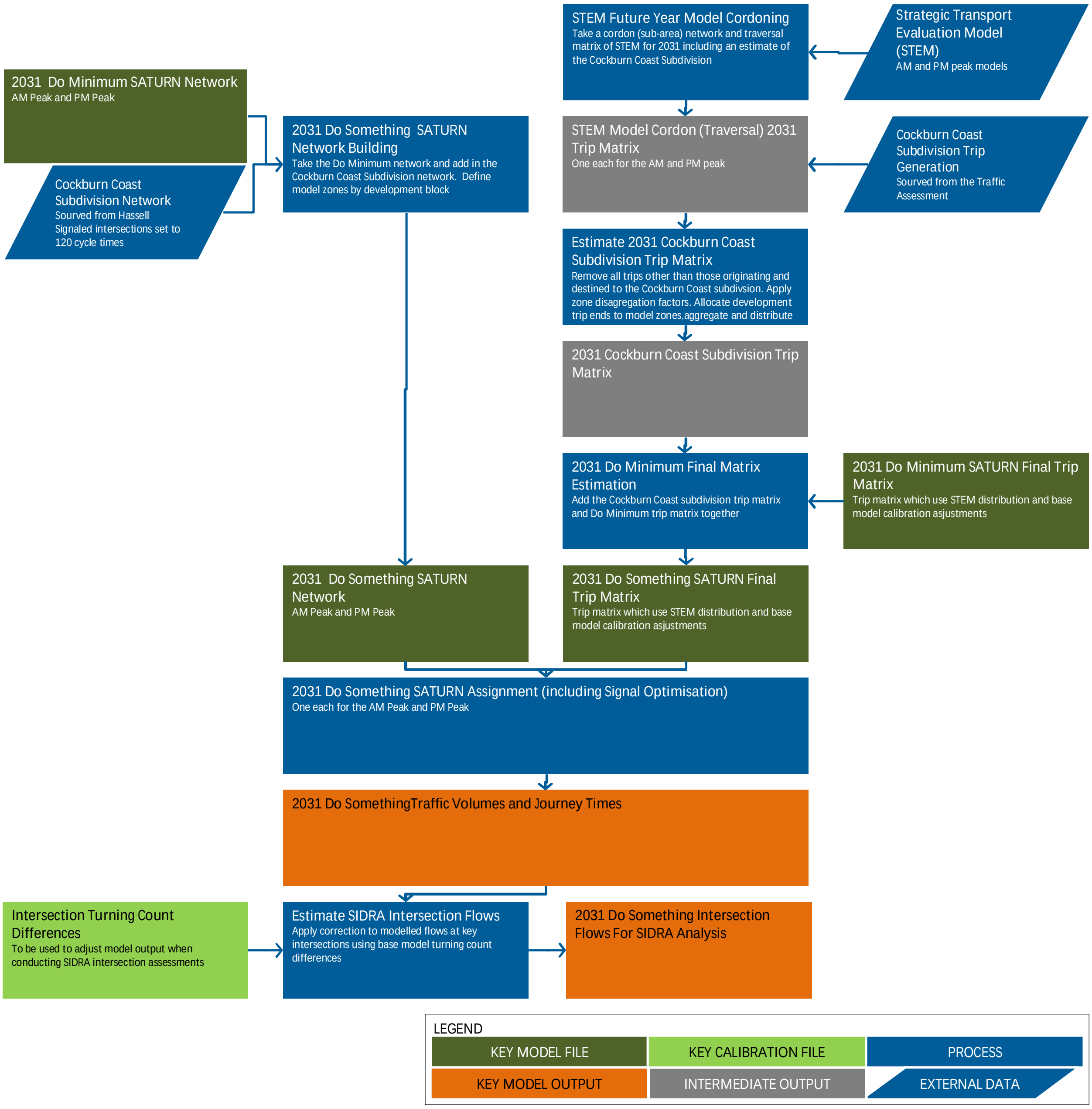


Figure 6-3 Flow diagram illustrating the process to develop the Do Something SATURN model

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The traffic generated by the Cockburn Coast development has been assessed using trip rates and the distribution has been identified using STEM.

Trip generation and mode share

Trip generation involved calculating the predicted volume of trips associated with the Cockburn Coast development. The trip rates presented in the typical land use vehicle trip rates table of the Western Australia Planning Commission publication: 'Transport Assessment Guidelines for Developments' have been assumed as a starting point. These are illustrated in Table 6.1.

Table 6.1 Trip generation rates

		AM peak hour trip rate		PM peak hour trip rate	
Land use	Unit	In	Out	In	Out
Residential	Dwellings	0.2	0.6	0.5	0.3
School	Pupils	0.5	0.5	0.5	0.5
Commercial	$100m^2$ GFA	1.6	0.4	0.4	1.6
Food retail	$100m^2$ GFA	2	0.5	5	5
Non-food retail	$100m^2$ GFA	1	0.25	2	2

These are based on surveys of comparable land uses or extracted from recognised land use traffic generation databases such as the Land Use Traffic Generation Guidelines, the Guide to Traffic Generating Developments (Roads and Traffic Authority NSW) and Trip Generation 7th edition (Institute of Transportation Engineers (ITE)).

Cockburn Coast is part of a Transit Oriented Development as a result of the introduction of the BRT. As detailed in the Cockburn Coast Integrated Transport Plan, residents in TODs tend to own fewer cars and drive less compared to automobile-dependent communities. Households often reduce their vehicle travel when they move to transit oriented locations. It is therefore proposed that the trip rates for the Cockburn Coast development would be lower than those proposed by the WAPC.

Research has been carried out into the impact of Transit Oriented Developments on vehicle trips. This has been documented in the Transit Cooperative Research Program (TCRP) Report 128 'Effects of TOD on Housing, Parking, and Travel'. The results show that Transit Oriented Developments averaged 44% fewer vehicle trips than estimated by the ITE Manual. During peak periods the differentials were even larger with 49% lower rates during the AM Peak hour and 48% lower rates during the PM Peak hour for a Transit Oriented Development. Another study carried out by Gard entitled 'Quantifying Transit Oriented Development's Ability to Change Travel Behaviour' looked at a mixed use Transit Oriented Development. This study identified that the number of new vehicle trips is reduced by 32%. The case studies used in both pieces of research had light rail systems in place as opposed to a Bus Rapid Transit. An LRT system will potentially attract a higher patronage than a BRT system and thus a more pessimistic percentage reduction would probably be more suitable for this study.

Muley (2011) used the Kelvin Grove Urban Village, located 2km north west of the Brisbane Central Business District to evaluate the transport impacts of a TOD from an Australian perspective. The analysis showed that when Kelvin Grove Urban Village was considered as a whole, a reduction of about 27 to 48% was observed for the AM and PM Peak hours when compared to ITE rates, whilst a reduction of 42% was observed for peak period traffic when compared to the RTA rates. This concurs with the American studies into Transit Oriented Developments.

The 'Public Transport for Perth in 2031' document produced by the Department of Transport suggests that by 2031 public transport will account for one-in-five motorised trips in the morning peak period. Currently public transport accounts for one-in-eight motorised trips. This equates to 20% mode share for public transport in 2031. A reduction of 20% in vehicle trips to account for the switch onto public transport is therefore considered to be reasonable for the Cockburn Coast development. It is proposed that the remaining 12% (to total the 32% stated in the Gard research) would switch mode to either walking or cycling and there would be a small number of internal trips. The percentage from the Gard research has been used as this will allow for a more pessimistic assessment of trips.

This assessment has therefore calculated the total number of trips for the proposed development assuming the trip rates detailed in the Western Australia Planning Commission publication as indicated in Table 6.1, and then reduced this number of trips by a total of 32% in both the AM Peak and PM peak hours as per the Gard research. This is indicated by the 'adjusted total' in Table 6.2. 20% of this reduction will switch to public transport and the remaining 12% will shift to walking and cycling modes and a small number will be internal trips.

Table 6.2 Trip generation totals for each precinct

ROBB JETTY PRECINCT										
AM PEAK HOUR (0700 – 0800)										
Land use	Residential trips		Commercial trips		Retail Trips		Total		Adjusted Total	
	In	Out	In	Out	In	Out	In	Out	In	Out
Low density residential	52.1	156.4	0.0	0.0	0.0	0.0	52.1	156.4	35.4	106.3
Medium density residential	162.4	487.2	0.0	0.0	0.0	0.0	162.4	487.2	110.4	331.3
High density residential	48.7	146.2	0.0	0.0	0.0	0.0	48.7	146.2	33.1	99.4
Mixed use	32.1	96.2	173.4	43.3	40.6	8.1	246.1	147.7	167.3	100.4
Activity centre	47.7	143.0	257.7	64.4	60.4	12.1	365.8	219.5	248.7	149.3
Community / commercial	0.0	0.0	0.0	0.0	4.7	0.9	4.7	0.9	3.2	0.6
Total	**343.0**	**1029.0**	**431.1**	**107.8**	**105.7**	**21.1**	**879.8**	**1158.0**	**598.3**	**787.4**
PM PEAK HOUR (1600 – 1700)										
Land use	Residential trips		Commercial trips		Retail Trips		Total		Adjusted Total	
	In	Out	In	Out	In	Out	In	Out	In	Out
Low density residential	130.3	78.2	0.0	0.0	0.0	0.0	130.3	78.2	88.6	53.2
Medium density residential	406.0	243.6	0.0	0.0	0.0	0.0	406.0	243.6	276.1	165.6
High density residential	121.8	73.1	0.0	0.0	0.0	0.0	121.8	73.1	82.8	49.7
Land use	Residential trips		Commercial trips		Retail Trips		Total		Adjusted Total	
	In	Out	In	Out	In	Out	In	Out	In	Out

ROBB JETTY PRECINCT										
Mixed use	80.2	48.1	43.3	173.4	81.3	32.5	204.8	254.0	139.3	172.7
Activity centre	119.2	71.5	64.4	257.7	120.8	48.3	304.4	377.5	207.0	256.7
Community / commercial	0.0	0.0	0.0	0.0	9.4	3.7	9.4	3.7	6.4	2.5
Total	**857.5**	**514.5**	**107.8**	**431.1**	**211.4**	**84.6**	**1176.7**	**1030.2**	**800.2**	**700.5**

HILL TOP PRECINCT										
AM PEAK HOUR (0700 – 0800)										
Land use	Residential trips		Commercial trips		Retail Trips		Total		Adjusted Total	
	In	Out	In	Out	In	Out	In	Out	In	Out
Low density residential	23.2	69.7	0.0	0.0	0.0	0.0	23.2	69.7	15.8	47.4
Medium density residential	33.0	99.0	0.0	0.0	0.0	0.0	33.0	99.0	22.4	67.3
High density residential	96.7	290.2	0.0	0.0	0.0	0.0	96.7	290.2	65.8	197.3
Mixed use	23.9	71.6	129.0	32.3	30.2	6.0	183.1	109.9	124.5	74.7
Total	**176.8**	**530.5**	**129.0**	**32.3**	**30.2**	**6.0**	**336.1**	**568.8**	**228.5**	**386.8**
PM PEAK HOUR (1600 – 1700)										
Land use	Residential trips		Commercial trips		Retail Trips		Total		Adjusted Total	
	In	Out	In	Out	In	Out	In	Out	In	Out
Low density residential	58.0	34.8	0.0	0.0	0.0	0.0	58.0	34.8	39.5	23.7
Medium density residential	82.5	49.5	0.0	0.0	0.0	0.0	82.5	49.5	56.1	33.7
High density residential	241.8	145.1	0.0	0.0	0.0	0.0	241.8	145.1	164.5	98.7
Mixed use	59.7	35.8	32.3	129.0	60.5	24.2	152.4	189.0	103.6	128.5
Total	**442.1**	**265.3**	**32.3**	**129.0**	**60.5**	**24.2**	**534.8**	**418.5**	**363.7**	**284.6**

POWER STATION PRECINCT										
AM PEAK HOUR (0700 – 0800)										
Land use	Residential trips		Commercial trips		Retail Trips		Total		Adjusted Total	
	In	Out	In	Out	In	Out	In	Out	In	Out
Low density residential	11.2	33.5	0.0	0.0	0.0	0.0	11.2	33.5	7.6	22.8
Medium density residential	20.0	59.9	0.0	0.0	0.0	0.0	20.0	59.9	13.6	40.7
High density residential	4.2	12.5	0.0	0.0	0.0	0.0	4.2	12.5	2.8	8.5
Mixed use	2.7	8.2	53.3	13.3	12.5	2.5	68.5	24.0	46.6	16.3

POWER STATION PRECINCT											
AM PEAK HOUR (0700 – 0800)											
Land use	Residential trips		Commercial trips		Retail Trips		Total		Adjusted Total	
	In	Out	In	Out	In	Out	In	Out	In	Out
Activity centre	75.3	226.0	398.7	99.7	56.7	11.3	530.7	337.0	360.9	229.1
Total	**113.4**	**340.1**	**452.0**	**113.0**	**69.2**	**13.8**	**634.5**	**466.9**	**431.5**	**317.5**
PM PEAK HOUR (1600 – 1700)										
Land use	Residential trips		Commercial trips		Retail Trips		Total		Adjusted Total	
	In	Out	In	Out	In	Out	In	Out	In	Out
Low density residential	27.9	16.7	0.0	0.0	0.0	0.0	27.9	16.7	19.0	11.4
Medium density residential	49.9	30.0	0.0	0.0	0.0	0.0	49.9	30.0	34.0	20.4
High density residential	10.4	6.2	0.0	0.0	0.0	0.0	10.4	6.2	7.1	4.2
Mixed use	6.8	4.1	13.3	53.3	25.0	10.0	45.1	67.4	30.7	45.8
Activity centre	188.3	113.0	99.7	398.7	113.4	45.4	401.4	557.0	272.9	378.8
Total	**283.4**	**170.0**	**113.0**	**452.0**	**138.4**	**55.3**	**534.8**	**677.3**	**363.6**	**460.6**

Trip distribution

The trips generated for the development were distributed using STEM. Specifically, STEM was run with a representation of the Cockburn Coast development and a trip matrix for the SATURN study area extracted. Following a conversion exercise to the SATURN zone system and network, the trip ends calculated in the trip generation stage were allocated to an appropriate SATURN zone in the Cockburn Coast development and factored by the STEM trip generation. Essentially, the number of development trips in the SATURN model matches those discussed in the Trip Generation section above but are distributed according to STEM which as well as considering trips to zones within the SATURN study area also considers travel to destinations and from origins which lie outside of it. STEM's distribution model is of a gravity model form which is common place in large strategic transport models. It has been assumed that vehicles will park close to the zones that they are travelling to in the model. Car parks have not been explicitly modelled.

6.7 Modelling results

Link flows

The link results for the Do Minimum scenario for the AM Peak hour and the PM Peak hour in 2031 are illustrated in Figure 6.4 and Figure 6.5. The link results for the Do Something scenario for the AM Peak hour and PM peak hour in 2031 are illustrated in Figure 6.6 and Figure 6.7. The flows are recorded in passenger car units (PCUs). The PCU estimates the relative impact that different types of vehicles have on the highway network compared to a single car.

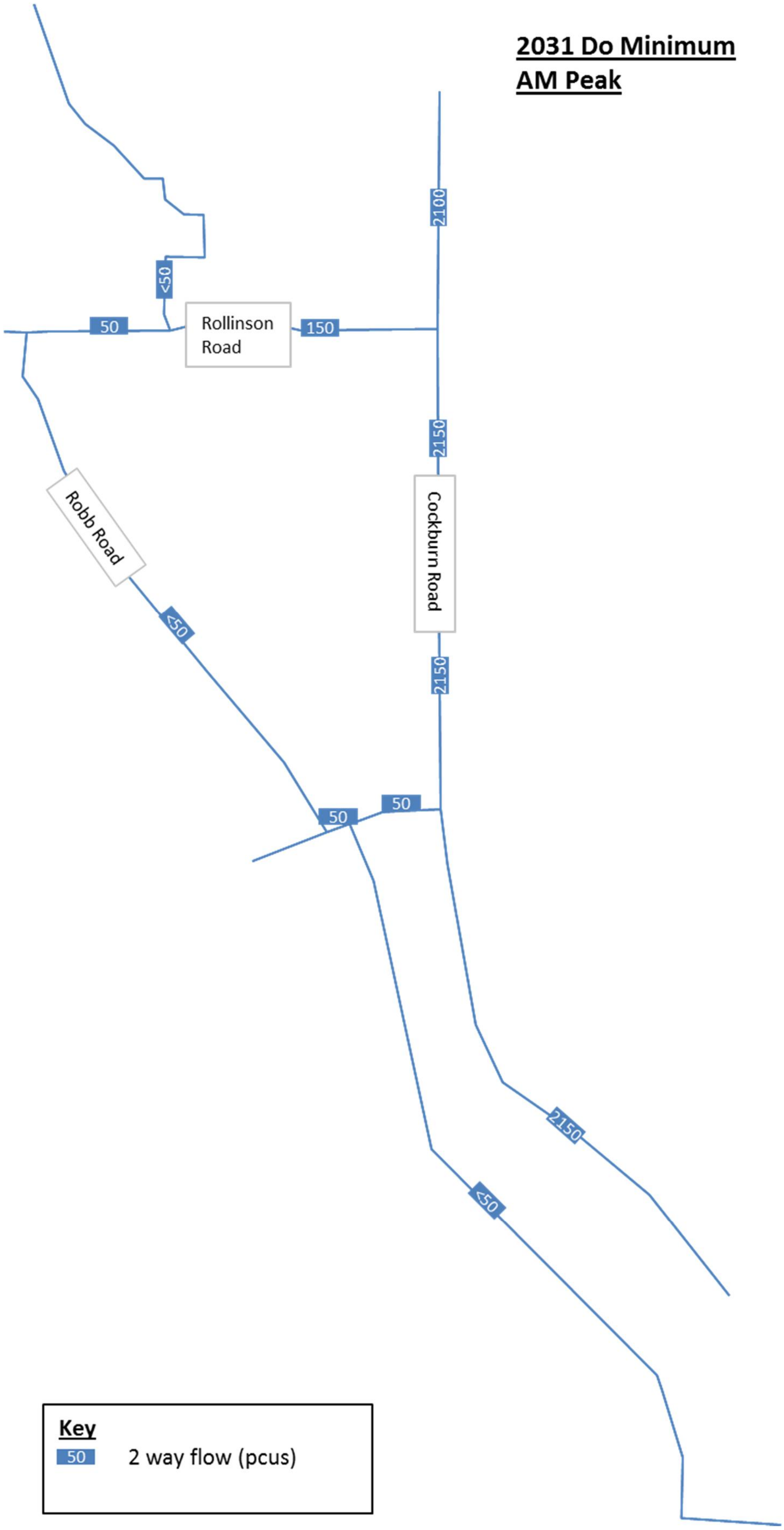

Figure 6-4 Do Minimum 2-way flows for the AM peak hour

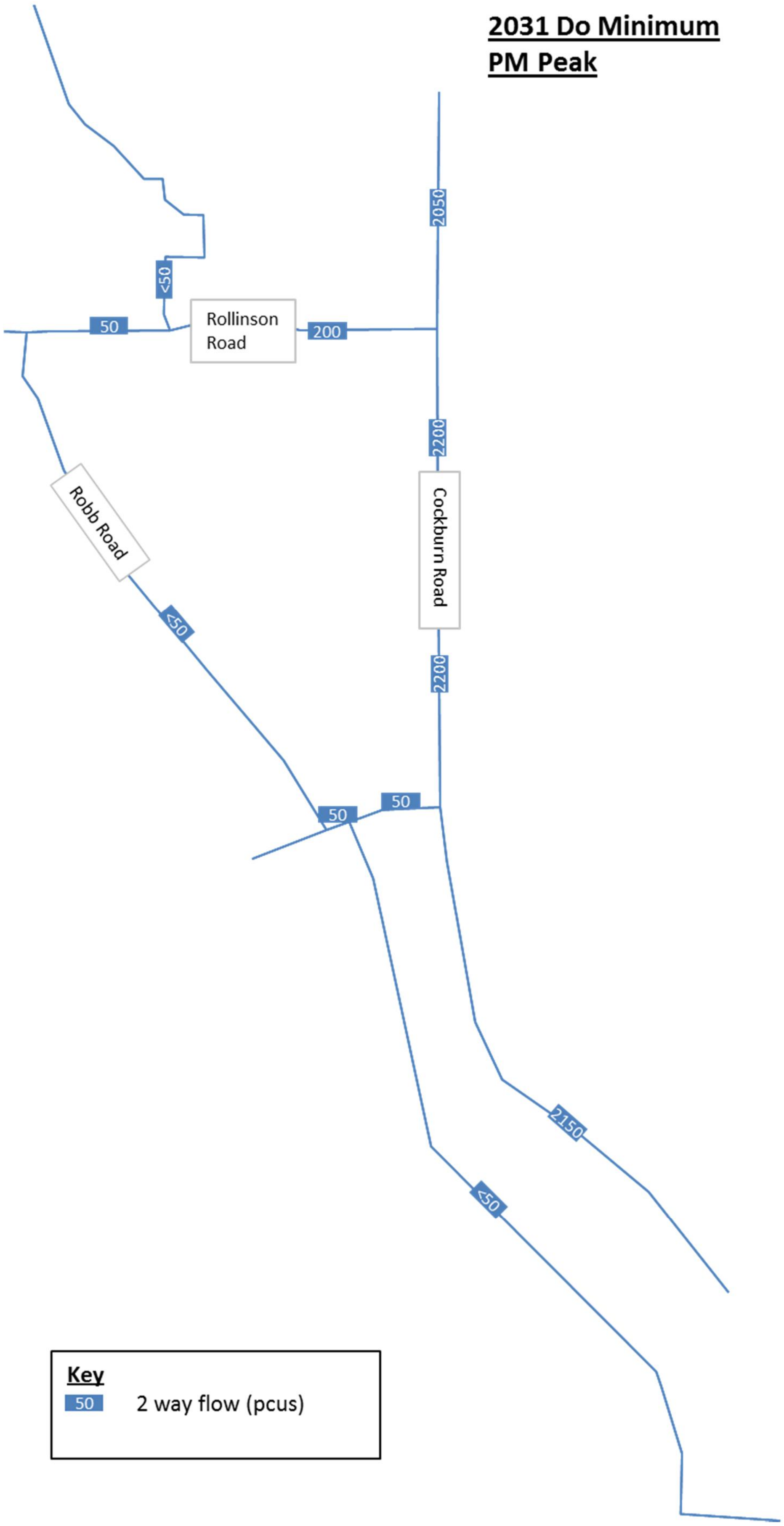

Figure 6-5 Do Minimum 2-way flows for the PM peak hour

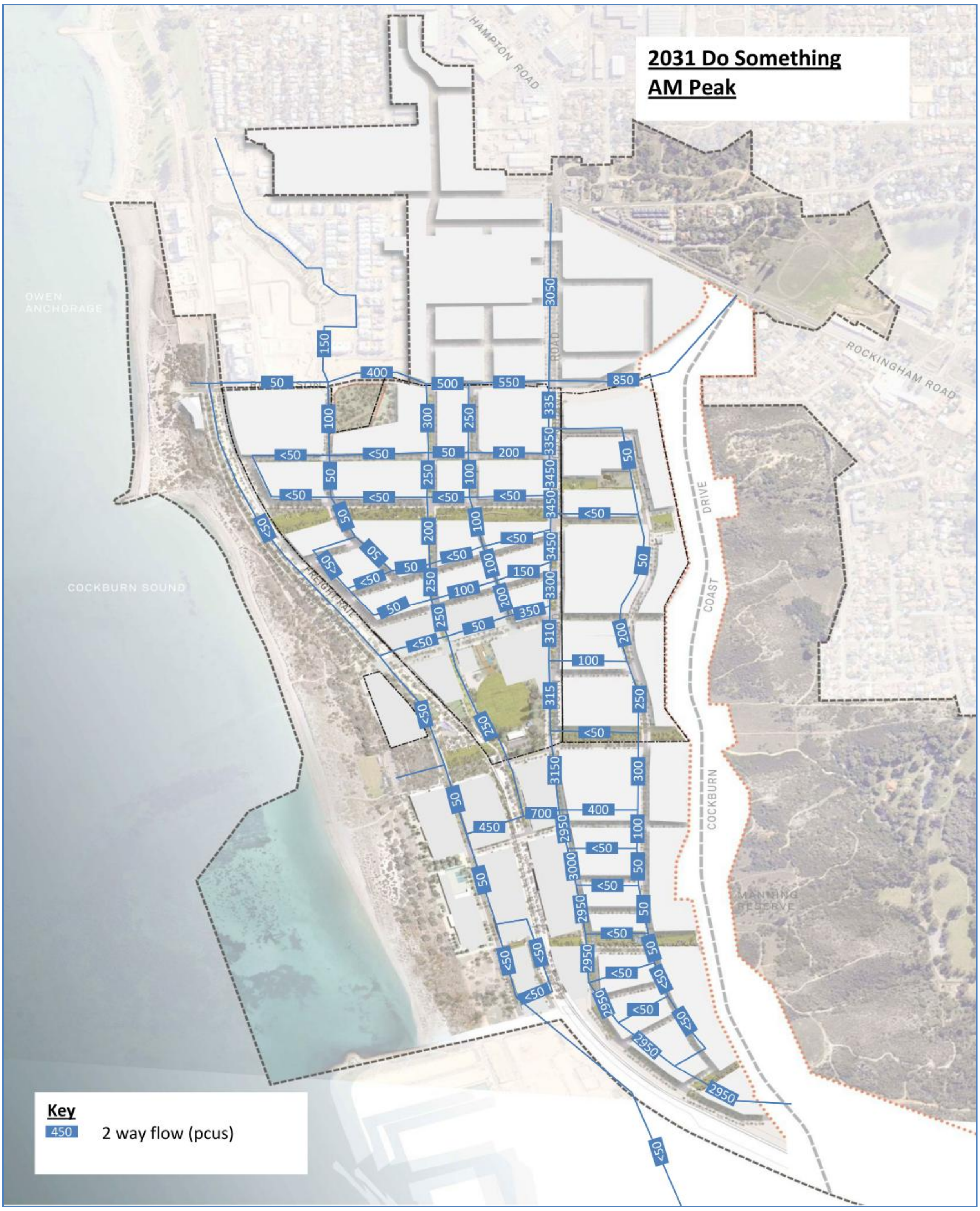

Figure 6-6 Do Something 2-way flows for the AM peak hour

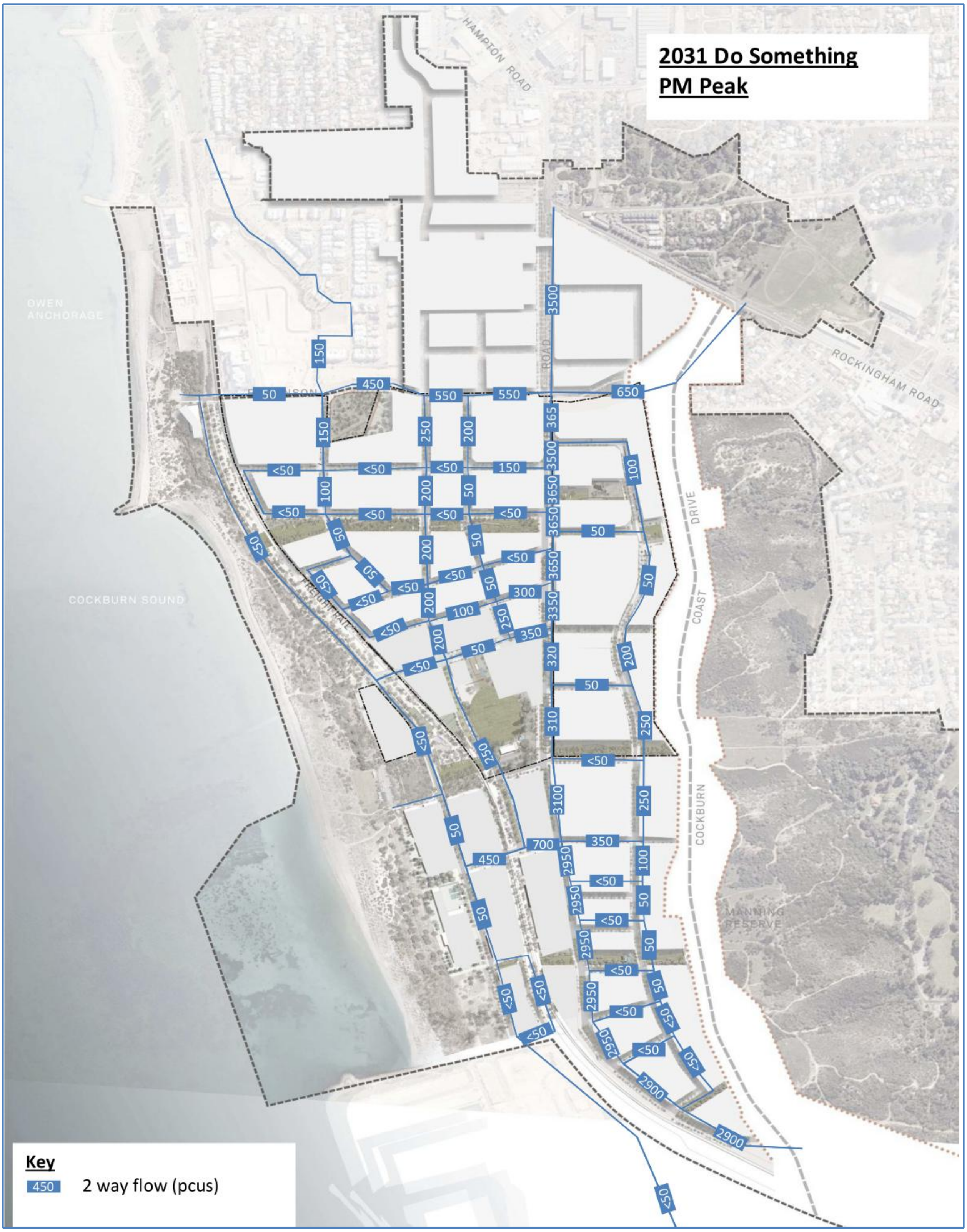

Figure 6-7 **Do Something 2-way flows for the PM peak hour**

As would be expected there is an increase in flows between the Do Minimum and Do Something scenarios in both the AM and PM Peak hours. The flow on Cockburn Road more than doubles between the base year and the Do Something scenario in both the morning and evening peak hours, whilst the flow on Rollinson Road increases by more than 50% between the Do Minimum and Do Something scenarios.

Although there are a number of routes into and out of the area, the majority of trips use Rollinson Road, Main Street and McTaggart Cove to access the development as illustrated in Figure 6.6 and Figure 6.7. This is as expected due to the fact that there are signals in each of these locations.

Journey times

In order to identify the impacts on the operation of Cockburn Road, consideration was made of the journey times along this route. A 'joy ride' was undertaken in each of the different model scenarios in both a northbound and southbound direction between the South Street intersection and south of the Spearwood Avenue intersection as illustrated on Figure 6.8.

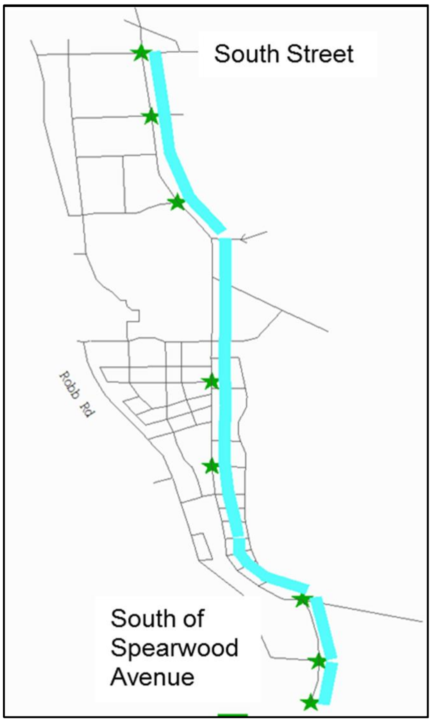

Figure 6-8 Joy ride along Cockburn Road

The journey times for each of the different modelled scenarios are detailed in Table 6.3.

Table 6.3 Journey times for each of the scenarios

	Journey Times (minutes)			
	AM peak		PM peak	
Scenario	Northbound	Southbound	Northbound	Southbound
Base year (2012)	6.0	5.5	5.5	8.5
Do Minimum (2031)	5.5	5.5	5.5	6.0
Do Something (2031)	9.5	7.5	7.5	10.5

It is evident that there is an improvement in the journey times between the base year and the Do Minimum scenario. This is as a result of the introduction of the BRT, the two lanes in each direction between Rockingham Road intersection and the Spearwood Avenue intersection, and the optimisation of signal timings across the study area. The journey time increases in both a northbound and southbound direction in the Do Something scenario as would be expected when the development is introduced. The Do Something journey times are however not significantly greater than those in the base year.

Rat running traffic

As discussed previously speeds within the development have been reduced in order to encourage walking and cycling. Reducing the speed of the road will also discourage rat running traffic as the journey time will increase and the route will become less attractive. Speeds have been reduced in the model to try to reduce the amount of rat running through Cockburn Coast. Reducing rat running traffic will also assist in the operation of the BRT.

Table 6.4 shows the percentage of non-development trips that are rat-running through the development.

Table 6.4 The percentage of non-development trips that are rat-running

	% of non-development trips which are rat running			
	AM peak		PM peak	
Scenario	Northbound	Southbound	Northbound	Southbound
Do Something (2031)	4%	3%	1%	2%

As Table 6.4 illustrates, with the development in place in 2031 and assuming two lanes in each direction on Cockburn Road between Rockingham Road and Spearwood Avenue, the majority of through trips chose to use Cockburn Road. There are only a small percentage of non-development trips that are rat-running through the development. This suggests that trips with an origin and destination outside the study area are tending to remain on the strategic routes rather than using the local routes through the development. Minimising rat running traffic through the development will have a positive impact on the internal roads and will allow priority to be given to the pedestrians and cyclists rather than the motor vehicle.

7. Analysis of transport networks: non-motorised user assessment

7.1 Pedestrian / cycle networks

Roads potentially difficult for pedestrians and cyclists to cross

The traffic assessment has identified the traffic volumes on roads within the Cockburn Coast study area. The traffic volumes for 2031 with Cockburn Coast are illustrated in Figure 6.6 and Figure 6.7. The WAPC Transport Assessment Guidelines for Developments details the traffic volumes affecting pedestrian crossing amenity. These traffic volumes are detailed in Table 7.1.

Table 7.1 Traffic volumes affecting pedestrian crossing amenity

Road cross-section	Traffic volume affecting ability of pedestrians to cross (vehicles per hour – two way)
2 lane undivided	1100 vph
2 lane divided (or with pedestrian refuge islands)	2800 vph
4 lane undivided (without pedestrian refuge islands)	700 vph
4 lane divided (or with pedestrian refuge islands)	1600 vph

Cockburn Road will be a 4 lane divided road with a median along its extent. This will have a two-way volume in excess of 1600 vph as detailed in Table 7.1. With these volumes, the ability of pedestrians and cyclists to cross Cockburn Road will be affected.

Hampton Road south of Douro Road is a 4 lane divided road. The traffic volumes are in excess of those detailed in Table 7.1. The ability of pedestrians and cyclists to cross this road will therefore also be affected.

Hampton Road north of Douro Road will be a 2 lane road. This will be divided to Scott Street however north of Scott Street to South Street the road will be a 2 lane undivided road. On the divided section the traffic volumes on Hampton Road do not exceed those detailed in Table 7.1 thereby will not affect the ability of pedestrians to cross. The traffic volumes on the undivided section of Hampton Road do however exceed those detailed in Table 7.1, so the ability of pedestrians and cyclists to cross this section of road will be affected.

The traffic volumes within the remainder of the study area are lower than those detailed in Table 7.1 for their respective road cross section category. Pedestrian crossing ability will therefore not be affected.

Proposed crossing facilities

When considering the WAPC guidelines and traffic volumes, it is evident that safe crossing facilities should be provided on Cockburn Road, Hampton Road south of Douro Road, and Hampton Road between Scott Street and South Street.

As part of the development, a number of crossing points will be provided on Cockburn Road. Pedestrians and cyclists will be able to cross at the Rollinson Road, Main Street and McTaggart Cove signalised intersections, with a further two dedicated signalised mid-block pedestrian crossings provided along the extent of Cockburn Road. These tie in with the pedestrian desire lines running east-west as previously discussed. These are illustrated in Figure 4.1. As detailed in the ITP the signals are to be pedestrian activated and signal phase timing should increase green time for pedestrian crossings rather than vehicular operations.

To ensure an efficient and safe pedestrian and cyclist network, safe crossing facilities should be considered at intervals no greater than those illustrated in Table 7.2.

Table 7.2 Intervals for crossing facilities

Road type	Maximum spacing of safe pedestrian crossing facilities
Arterial – minimal frontage activity	400 metres
Arterial – significant frontage activity	200 metres
Local distributor / Neighbourhood connector	100 metres

The greatest distance between crossing points on Cockburn Road is 324m between McTaggart Cove intersection and the pedestrian activated crossing to the south. Cockburn Road performs both a local and regional traffic function so it is appropriate to make reference to the 'Arterial' road type in this instance. The section between the McTaggart Cove intersection and the pedestrian activated crossing is expected to have minimal frontage activity. The spacing between crossing facilities is therefore within the guidelines for the maximum spacing of safe pedestrian crossing facilities. The distance between crossing points along Cockburn Road is reduced to the north of McTaggart Cove facilitating pedestrian and cyclist movements in the area. Pedestrian crossings will have generous pedestrian crossing provision to further facilitate pedestrian and cyclist movements in the area.

Zebra crossings are to be used throughout the residential streets within the development that cross the east west greenways. These will be combined with raised intersections and entry treatments in strategic locations for additional traffic calming as illustrated on Figure 4.3. Modelling shows that the traffic volumes on these routes will not exceed the specified traffic volumes for a 2 lane undivided road.

7.2 Safe walk to school assessment

A school is proposed within the Robb Jetty precinct on the corner of Main Street and Cockburn Road. This will be a primary school and will serve the development itself. There are no other schools within 800m of the boundary of the structure plan area.

There is potential that people from outside the study area could travel to the primary school proposed within Cockburn Coast, however it is likely that existing schools located outside the 800m perimeter would serve the existing residential developments. The catchment for the proposed primary school is likely to be restricted to the Cockburn Coast area. The most likely walk and cycle routes to the school from the catchment area are illustrated in Figure 7.1.

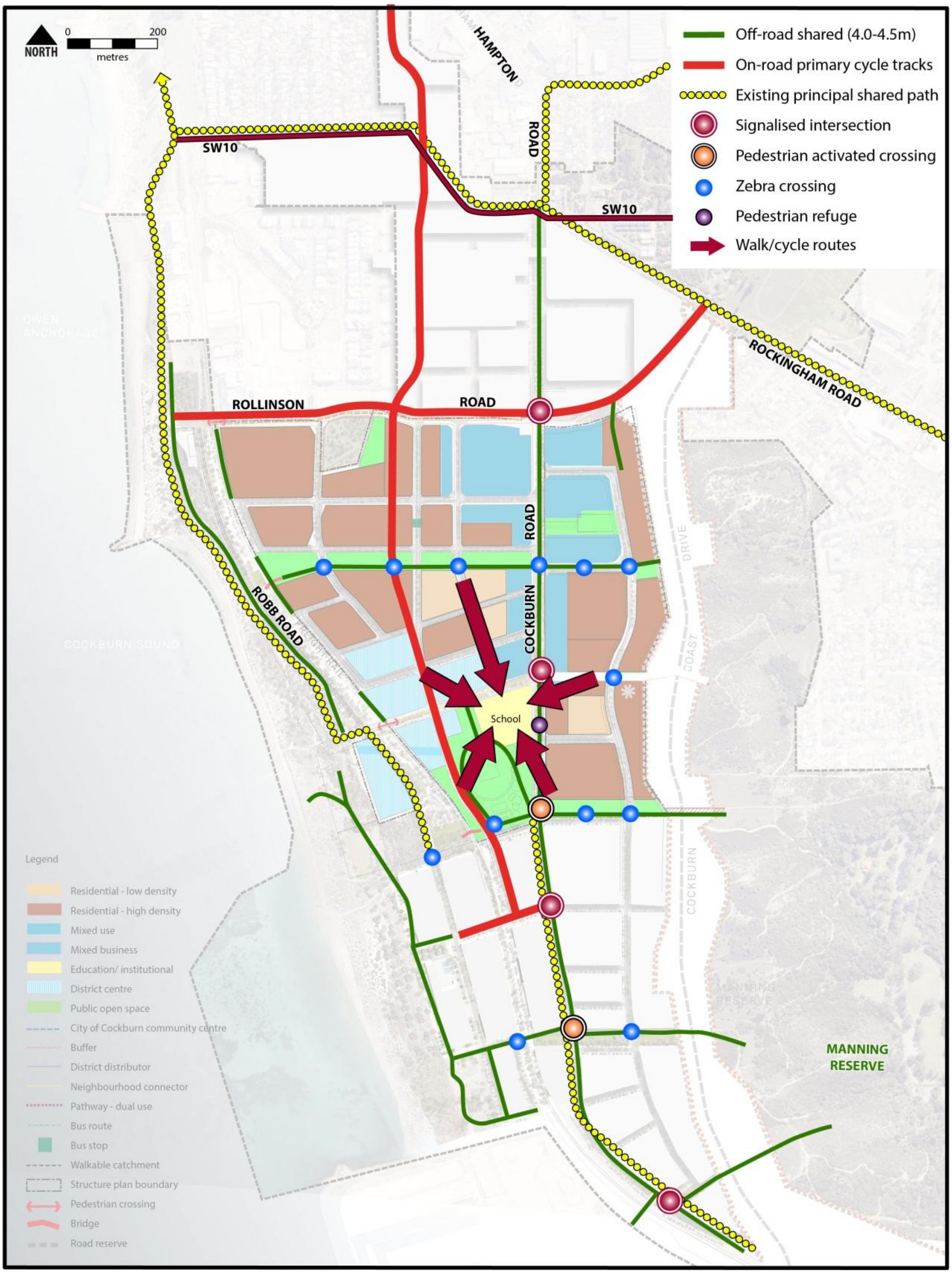

Figure 7-1 Pedestrian routes to school

The majority of trips to and from the school will travel ithin Cockburn Coast, converging in the locations indicated on Figure 7.1. The routes through the development will be designed to give priority to pedestrians and cyclists. The traffic flows on these internal roads are lower than those detailed in Table 7.1 for two lane undivided roads. It is recognised that school children, particularly primary school children may experience difficulties at lower traffic levels. The traffic volumes on the internal routes through the development are sufficiently low to allow for the safe movement of children to and from the school. The presence of zebra crossings throughout the residential streets will also provide safe crossing points.

In the immediate vicinity of the school where the walk / cycle trips converge, there is an off-road shared path. This is immediately adjacent to the school and will provide safe access to the school site. An on-road cycle track runs north-south on the internal streets through the development. This will connect to the off-road shared path. An on-road cycle track will also run north-south along Cockburn Road.

As previously discussed the two-way traffic volumes on Cockburn Road will be in excess of 1600vph. The ability of pedestrians and cyclists to cross the road will be affected. This will obviously have an impact on the ability of the school children to cross safely. A signalised intersection is therefore proposed at the Main Street / Cockburn Road intersection. This intersection will have pedestrian activated signals. This intersection is directly adjacent to the proposed school site and will provide a crossing point for those travelling to and from the school from the east of the development. There is also a pedestrian refuge to the south of the Main Street / Cockburn Road intersection. This will provide an additional crossing point to the south of the school.

Footpaths will be constructed on the internal routes through the development and along Cockburn Road, providing a safe route to school for residents. A number of streets will be designed as shared streets. These are illustrated on Figure 4.3. These will have a speed limit of 10 km/hr. The speeds on streets throughout the remainder of the development will have a maximum posted speed of 30 km/hr with the exception of Cockburn Road which will have a 50km/hr posted speed. Cockburn Road (within the school zone) will be 30 km/hr during school times. The posted speeds and higher level of pedestrian activity will promote slower than conventional travel speeds.

The section of Main Street directly outside the school is not proposed to be a shared street. It is therefore recommended that a dedicated crossing point be introduced on Main Street outside the school to provide a safe crossing location. This could be in the form of a supervised children's crossing. This would ensure there is a safe, controlled environment in the area closest to the school.

The majority of trips to and from the school will travel within Cockburn Coast, and thus sustainable modes of travel will be encouraged to access the school site. It is however recognised that sustainable modes may not be suitable for all trips to the school. Traffic congestion and parking can be an issue around schools as children are dropped off and collected in private vehicles. A short drop off and pick up point will need to be considered as part of the school site design to ensure that vehicles are not blocking Main Street or any of the other internal streets and most importantly not waiting on Cockburn Road.

7.3 Pedestrian permeability and access to public transport

Cockburn Coast will be designed to provide a permeable walking and cycling network, with visual and physical connectivity to other streets and places. There will be clear visual links between streets and places with adequate lighting provision along the routes. The design of the streets has been carefully linked with the design of the BRT. The BRT corridor will be created along Cockburn Road and through the development connecting Fremantle to Rockingham. BRT stops are located approximately every 400-600 metres. The proposed BRT coupled with the stop locations for existing services in the area, means that all of the residential dwellings in the proposed development are within 500m walk of bus stops as illustrated on Figure 7.2. It has been assumed in subsequent analysis that 95% of the development is located within 400m of quality public transport.

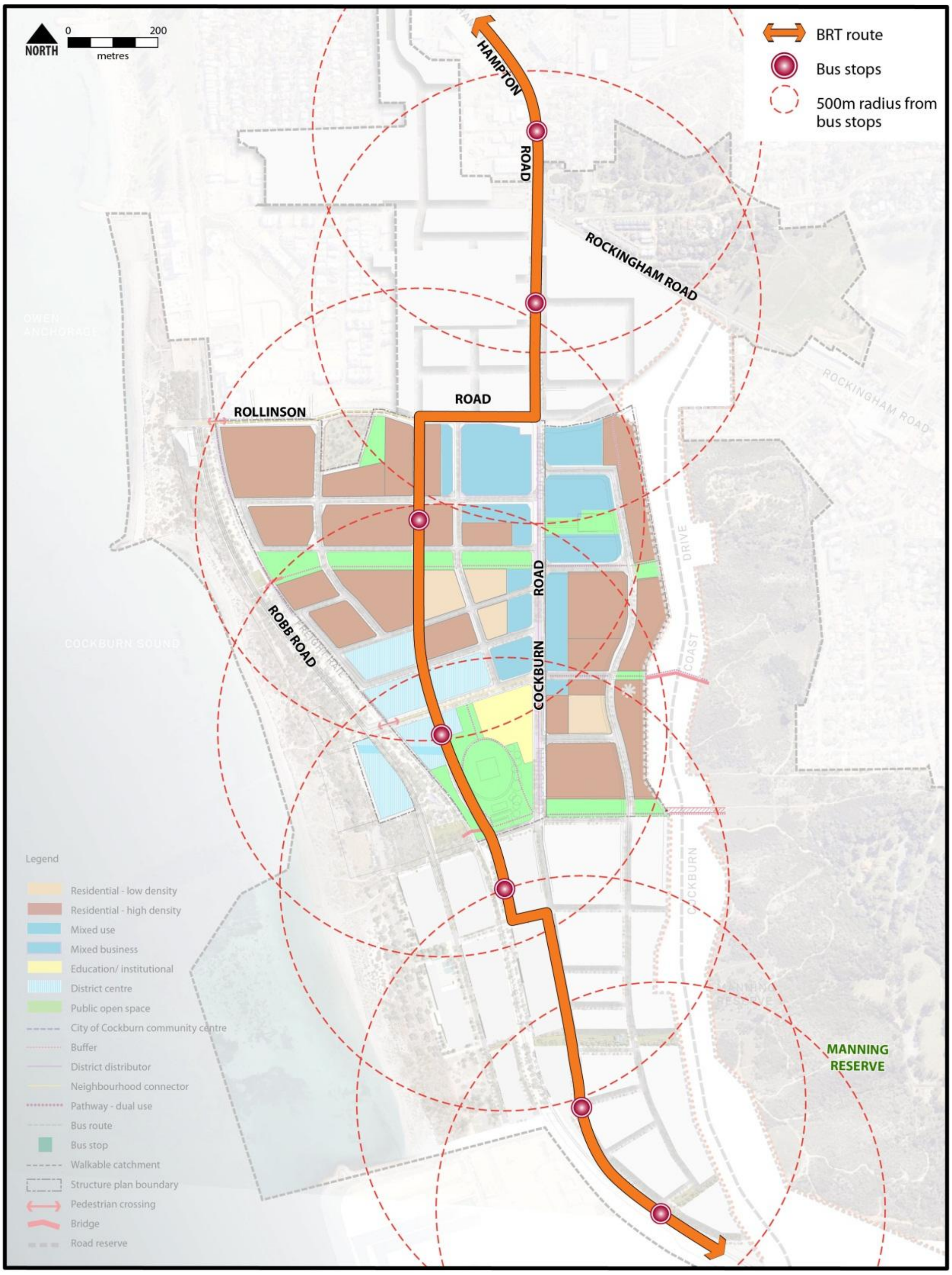

Figure 7-2 500m radius from bus stops

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8. Intersection operation

8.1 Assessment method

A detailed intersection operational analysis has been undertaken for the following intersections:

- Rollinson Road / Cockburn Road
- Main Street / Cockburn Road
- McTaggart Cove / Cockburn Road
- Spearwood Avenue / Cockburn Road

SIDRA 5.1 has been used to undertake this assessment. The above intersections have been chosen for analysis as they are situated on the Cockburn Road corridor immediately adjacent to Cockburn Coast. The development is likely to have the most significant impact on these intersections.

The traffic flows from the 2031 Do Minimum and 2031 Do Something SATURN model have been used in the assessment of the individual intersections. The flows output from the SATURN model have been adjusted according to the difference between the modelled and the observed flows in the base year. The flows for each of the Do Minimum and Do Something scenarios for the AM and PM Peak hours are illustrated in Appendix B. These flows are recorded in vehicles for use in the SIDRA software.

The following sections provide an analysis of the performance of each intersection in the Do Minimum and Do Something scenarios.

8.2 Rollinson Road / Cockburn Road

The Rollinson Road / Cockburn Road intersection is currently a 3 arm priority intersection with Rollinson Road as the minor arm. The existing layout is shown in Figure 8.1.

Figure 8-1 Rollinson Road / Cockburn Road existing layout

The proposed future year layouts as modelled in SIDRA are illustrated in Figure 8.2. In the Do Minimum scenario the intersection will remain as a 3 arm intersection. There will be a bus lane on the approach to the intersection on Cockburn Road North and Rollinson Road and on the exits of these arms to accommodate the BRT. In the Do Something scenario, the intersection will be a 4 arm intersection to allow access to the development to the west and east of Cockburn Road. There will again be a bus lane on the approach to the intersection on Cockburn Road North and Rollinson Road and on the exits to these arms to accommodate the BRT.

The BRT intersections have been optimised in SIDRA. The proposed layout is shown below and has the bus lane terminating before reaching the stop line and the bus sharing the left turn lane with other vehicles. The bus would 'jump' the queue to the end of the bus lane and would be able to clear the stop line in one cycle of the lights.

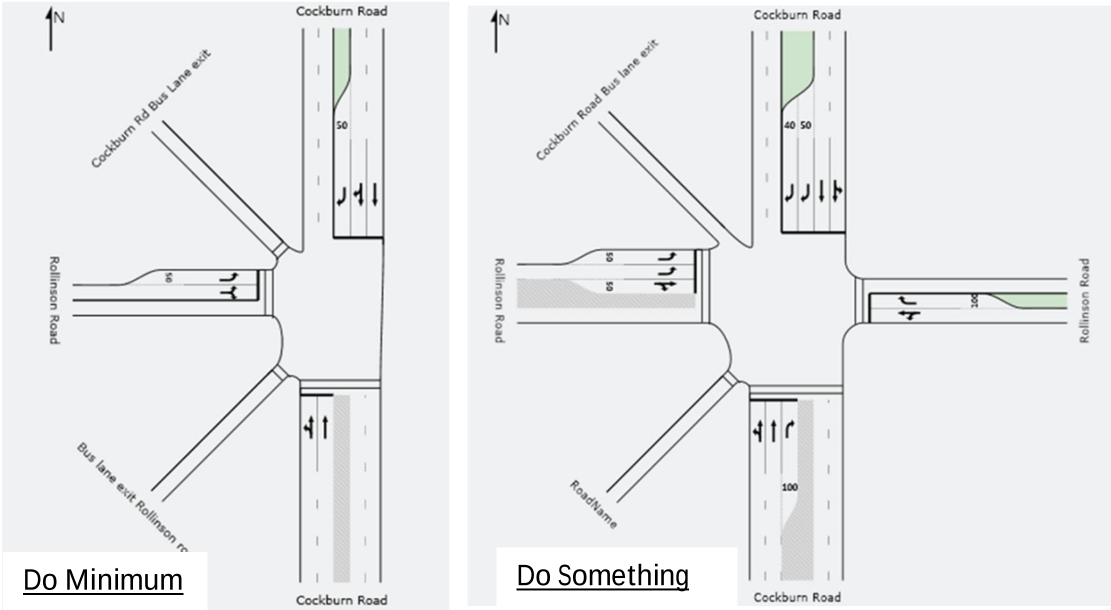

Figure 8-2 SIDRA layout for Rollinson Road / Cockburn Road intersection

The signal phasing adopted and the signal cycle and phase times are shown in Figure 8.3 and Table 8.1.

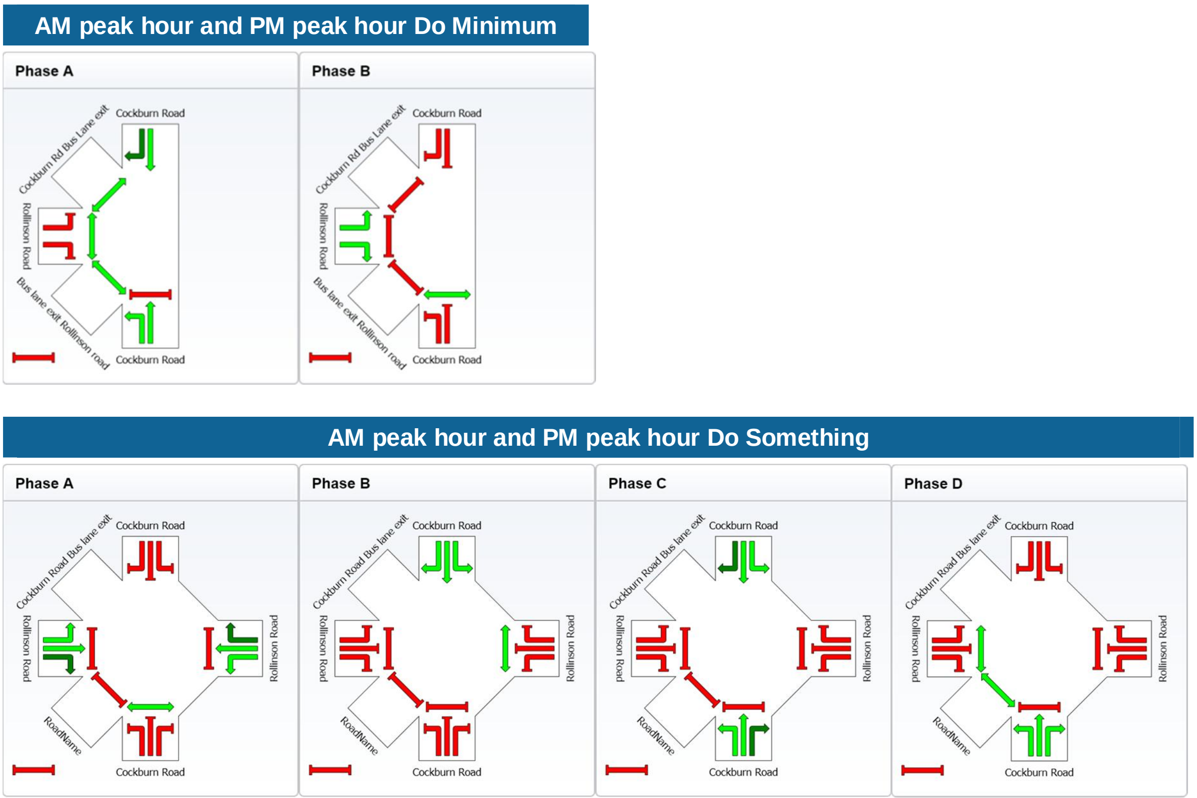

Figure 8-3 Signal phasing for Rollinson Road / Cockburn Road intersection

Table 8.1 Phase times and cycle times for Rollinson Road / Cockburn Road intersection (seconds)

Phase	Do Minimum		Do Something	
	AM Peak Hour	PM Peak hour	AM Peak Hour	PM Peak hour
A	80	80	30	28
B	20	40	23	24
C	N/A	N/A	44	44
D	N/A	N/A	23	24
Cycle Time	**100**	**120**	**120**	**120**

The performance of the intersection is detailed in Table 8.2 and Table 8.3 for the AM and PM peak hours respectively.

Table 8.2 AM Peak hour SIDRA results for Rollinson Road / Cockburn Road

AM Peak Approach	Movement	Do Minimum				Do Something			
		DoS	LoS	Delay (s)	Queue (m)	DoS	LoS	Delay (s)	Queue (m)
Cockburn Road North	Left / Through	N/A				0.748	C	25.2	248.8
	Through	0.384	A	5.0	71.2	0.748	C	24.9	249.3
	Right	0.214	B	15.4	8.8	0.272	C	29.7	18.1
	Right	N/A				0.272	C	29.6	15.8
Rollinson Road (West)	Left	0.215	D	49.0	15.8	0.507	D	50.9	38.8
	Left	N/A				0.507	D	53.2	70.0
	Through / Right	N/A				0.508	E	57.3	41.6
	Left/Right	0.215	D	49.2	17.9	N/A			
Cockburn Road South	Left / Through	0.307	A	5.2	51.2	0.575	C	22.1	163.9
	Through	0.307	A	4.6	51.3	0.575	C	21.8	164.1
	Right	N/A				0.997	E	67.0	163.2
Rollinson Road (East)	Left / Through	N/A				0.884	E	68.8	154.3
	Right	N/A				0.186	E	67.2	8.1
Overall Intersection		**0.384**	**A**	**7.4**	**71.2**	**0.997**	**D**	**35.7**	**249.3**

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Table 8.3 PM Peak hour SIDRA results for Rollinson Road / Cockburn Road

AM Peak Approach	Movement	Do Minimum DoS	Do Minimum LoS	Do Minimum Delay (s)	Do Minimum Queue (m)	Do Something DoS	Do Something LoS	Do Something Delay (s)	Do Something Queue (m)
Cockburn Road North	Left / Through	N/A				0.957	E	62.8	541.6
	Through	0.597	B	14.8	179.8	0.957	E	62.6	542.1
	Right	0.191	C	24.0	10.4	0.322	C	31.3	19.6
	Right	N/A				0.322	C	31.1	17.0
Rollinson Road (West)	Left	0.160	D	40.3	11.6	0.281	D	51.4	21.0
	Left	N/A				0.281	D	52.5	34.3
	Through / Right	N/A				1.101	F	268.2	81.6
	Left/Right	0.160	D	41.3	26.0	N/A			
Cockburn Road South	Left / Through	0.293	B	12.9	67.2	0.669	C	22.9	205.2
	Through	0.293	B	11.3	9.4	0.669	C	22.8	205.4
	Right	N/A				0.253	D	52.0	32.6
Rollinson Road (East)	Left / Through	N/A				1.226	F	485.6	655.1
	Right	N/A				0.093	E	58.8	6.6
Overall Intersection		**0.597**	**B**	**15.5**	**179.8**	**1.226**	**F**	**92.9**	**655.1**

The results indicate that the Rollinson Road / Cockburn Road intersection is operating satisfactorily in both the AM and PM Peak hours in the Do Minimum scenario. The Degree of Saturation is within acceptable limits on all arms of the intersection. It is generally accepted that the Degree of Saturation must be below 0.85 to operate satisfactorily. The average vehicle delay does not exceed the 55 seconds detailed in the WAPC Transport Assessment Guidelines for Developments for any of the movements. Queuing is evident on Cockburn Road North in the PM Peak hour, however the delay to these vehicles is minimal and they cross the stop line within one cycle of the lights.

In the Do Something scenario, delay starts to become apparent at the intersection. Adding an additional arm to the intersection, coupled with bus priority and development traffic results in delays in excess of 55 seconds for the right turn into Rollinson Road East and all movements on the Rollinson Road arm in the AM Peak hour. The delay is not significant however with the maximum delay (68.8 seconds) recorded on Rollinson Road East for the left / through movement. Delays in excess of 55 seconds are evident on Cockburn Road North in the PM Peak hour, and out of the development on Rollinson Road West and Rollinson Road East. Although queuing is evident on Cockburn Road, the delay to vehicles is only 62.8 seconds which is not considerable and vehicles in the queue will clear the stop line in one cycle of the lights. The operation of the main line traffic is therefore considered to be acceptable. The most delay is experienced by vehicles on the side roads with considerable queuing evident on Rollinson Road East in particular. Although congestion is evident on this arm, congestion in general may be beneficial in the study area as this could encourage greater uptake of the BRT which would in turn reduce the demand on the intersections.

8.3 Main Street / Cockburn Road

The Main Street / Cockburn Road intersection currently does not exist. This intersection would allow access to and from the development. The proposed layout as modelled in SIDRA is illustrated in Figure 8.4. The intersection will be a 3 arm signalised intersection with all movements permitted from all arms of the intersection.

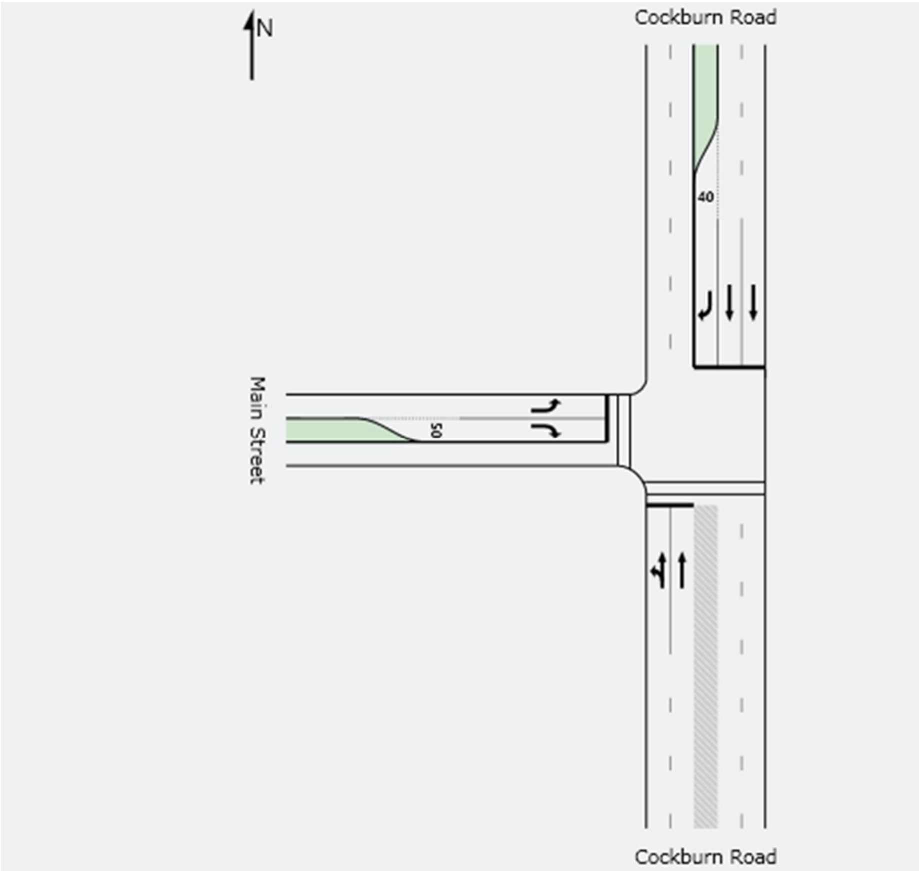

Figure 8-4 SIDRA layout for Main Street / Cockburn Road intersection

The signal phasing adopted and the signal cycle and phase times are shown in Figure 8.5 and Table 8.4.

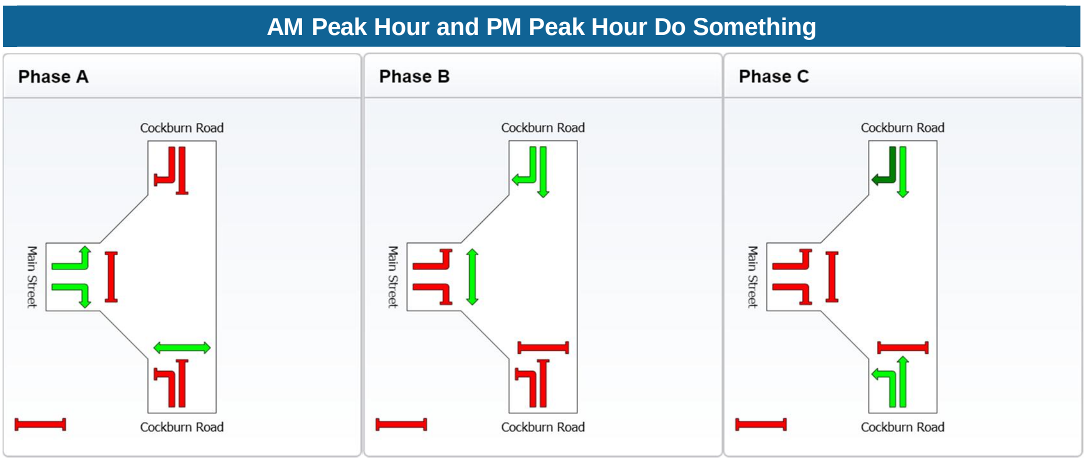

Figure 8-5 Signal Phasing for Main Street / Cockburn Road intersection

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Table 8.4 Phase times and cycle time (seconds)

Phase	AM Peak Hour	PM Peak hour
A	21	21
B	21	22
C	58	47
Cycle Time	**100**	**90**

The performance of the intersection is detailed in Table 8.5 and Table 8.6 for the AM and PM peak hours respectively. As the intersection would not be required if the development were not in place, this intersection has only been modelled for the Do Something scenario.

Table 8.5 AM Peak hour SIDRA results for Main Street / Cockburn Road

AM Peak Approach	Movement	Do Something			
		DoS	LoS	Delay (s)	Queue (m)
Cockburn Rd North	Right	0.769	C	34.8	63.9
	Through	0.512	A	6.2	109.0
Main Street	Left	0.039	D	47.7	3.2
	Right	0.133	D	48.6	9.6
Cockburn Rd South	Left / Through	0.743	C	20.5	202.1
	Through	0.743	C	20.1	202.7
Overall Intersection		**0.769**	**B**	**15.8**	**202.7**

Table 8.6 PM Peak hour SIDRA results for Main Street / Cockburn Road

PM Peak Approach	Movement	Do Something			
		DoS	LoS	Delay (s)	Queue (m)
Cockburn Road North	Right	0.698	C	23.7	47.9
	Through	0.688	A	8.3	166.4
Main Street	Left	0.032	D	42.3	2.6
	Right	0.198	D	43.7	14.3
Cockburn Road South	Left / Through	0.682	C	21.2	148.3
	Through	0.682	C	20.8	148.6
Overall Intersection		**0.698**	**B**	**14.7**	**166.4**

The results indicate that the intersection operates satisfactorily in both the AM and PM peak hours in the Do Something scenario (with Cockburn Coast). The Degree of Saturation is within acceptable limits on all arms of the proposed intersection. It is generally accepted that the Degree of Saturation must be below 0.85 to operate satisfactorily. The average vehicle delay does not exceed the 55 seconds detailed in the WAPC Transport Assessment Guidelines for Developments for any of the movements, with the overall average vehicle delay at the intersection being 15.8 seconds and 14.7 seconds in the AM and PM Peak hours respectively. Although the queuing is reasonably high on Cockburn Road, the delay is such that the vehicles are clearing the stop line within the cycle of the lights. A Level of Service B is experienced at the intersection.

8.4 McTaggart Cove / Cockburn Road

The McTaggart Cove / Cockburn Road intersection is currently a minor priority intersection with McTaggart Cove as the minor approach. The existing layout is shown in Figure 8-6.

Figure 8-6 McTaggart Cove / Cockburn Road existing layout

It is proposed that the McTaggart Cove / Cockburn Road intersection be moved further south to provide an access to and from the development. The proposed layout for this intersection as modelled in SIDRA is illustrated in Figure 8.7. McTaggart Cove / Cockburn Road intersection will be a 4 arm signalised intersection in the future providing access to and from the development either side of Cockburn Road.

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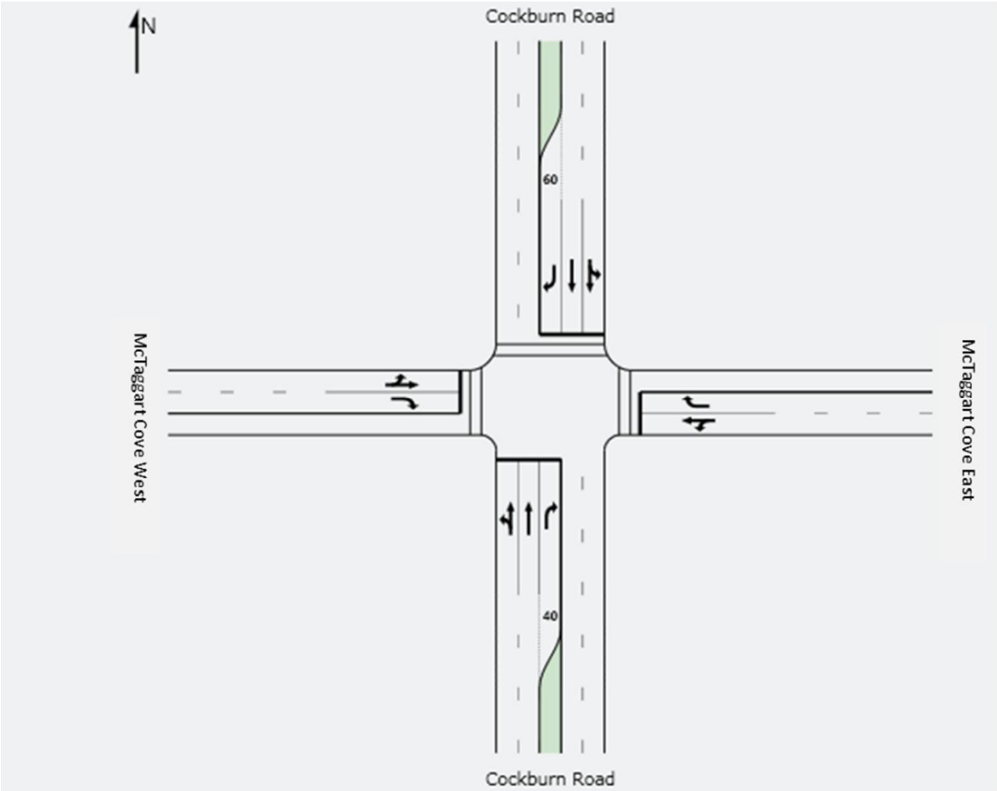

Figure 8-7 SIDRA layout for McTaggart Cove / Cockburn Road intersection

The signal phasing adopted and the signal cycle and phase times are shown in Figure 8.8 and Table 8.7.

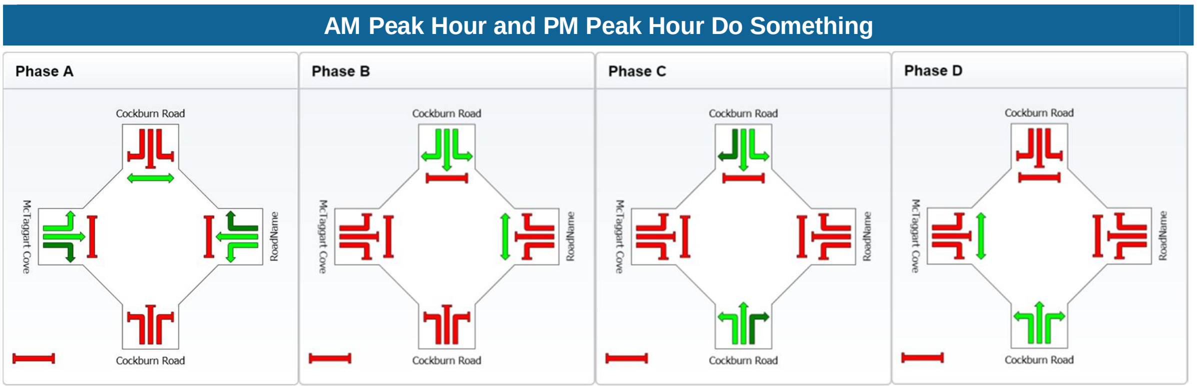

Figure 8-8 Signal Phasing for McTaggart Cove / Cockburn Road intersection

Table 8.7 Phase times and cycle time (seconds)

Phase	AM Peak Hour	PM Peak hour
A	39	40
B	19	20
C	24	40
D	18	20
Cycle Time	**100**	**120**

The performance of the intersection is detailed in Table 8.8 and Table 8.9 for the AM and PM peak hours respectively. As the proposed layout would not be required in the Do Minimum Scenario (without Cockburn Coast), this intersection has only been modelled for the Do Something scenario.

Table 8.8 AM Peak hour SIDRA results for McTaggart Cove / Cockburn Road

AM Peak Approach	Movement	Do Something			
		DoS	LoS	Delay (s)	Queue (m)
Cockburn Road North	Right	0.811	D	41.4	74.2
	Through	0.876	D	42.8	249.1
	Left / Through	0.876	D	43.0	248.7
McTaggart Cove East	Left / Through	0.124	C	26.0	18.7
	Right	0.855	E	58.7	106.9
Cockburn Road South	Left / Through	0.880	D	46.3	234.7
	Through	0.880	D	43.4	240.3
	Right	0.494	D	46.4	38.7
McTaggart Cove West	Left/ Through	0.351	D	35.6	55.9
	Right	0.595	D	38.2	77.7
Overall Intersection		**0.880**	**D**	**43.8**	**249.1**

Table 8.9 PM Peak hour SIDRA results for McTaggart Cove / Cockburn Road

PM Peak Approach	Movement	Do Something			
		DoS	LoS	Delay (s)	Queue (m)
Cockburn Road North	Right	0.736	D	37.8	71.5
	Through	0.918	D	50.7	387.3
	Left / Through	0.918	D	50.8	387.1
McTaggart Cove East	Left / Through	0.129	D	42.3	20.6
	Right	1.061	F	214.4	174.5
Cockburn Road South	Left / Through	0.489	C	27.5	122.1
	Through	0.489	C	24.8	124.6
	Right	0.529	E	56.7	41.6
McTaggart Cove West	Left/ Through	0.590	D	47.9	110.3
	Right	0.762	E	56.3	115.1
Overall Intersection		**1.061**	**D**	**53.3**	**387.3**

The results indicate that the McTaggart Cove / Cockburn Road intersection is operating close to capacity. During the AM Peak hour the Degree of Saturation exceeds the acceptable value on Cockburn Road North and South. The Degree of Saturation is not significantly above the 0.85 limit however. Although the Degree of Saturation is slightly above the acceptable limits, the average delay for vehicles is lower than the 55 seconds detailed in the WAPC Transport Assessment Guidelines for Developments, for all movements except the right turn out of McTaggart Cove East. Although this movement exceeds the acceptable level in guidance, the delay is not occurring to the main line traffic. It is considered acceptable to have this level of delay on the minor arm of the intersection. A certain amount of delay could be beneficial within Cockburn Coast as this may encourage greater uptake of the BRT. Again queuing is evident on Cockburn Road however as the delay is not significant it is anticipated that the vehicles will clear the stop line within one cycle of the lights.

In the PM Peak hour the Degree of Saturation exceeds acceptable levels on Cockburn Road North and on McTaggart Cove (right turn). Although there is queuing evident on Cockburn Road, the delay is not considerable and it is below the 55 seconds detailed in the WAPC guidelines. As the delay is minimal, it is expected that the queuing vehicles will clear the stop line within one cycle of the lights. SIDRA shows an excessive delay and a Level of Service on McTaggart Cove East for right turning traffic. Level of Service F represents a gridlock situation for that movement and in reality that would not occur. This result combined with a poor Level of Service for vehicles turning right out of Rollinson Road indicates that there will be significant difficulty turning to the north from the Emplacement precinct in the evening peak. This is due to the high flow of traffic leaving the Fremantle area at the end of the day. In reality, people would choose not to make this movement in the evening peak or would travel straight ahead into Robb Jetty or Power Station precincts and find their way north through the development. The volume of vehicles turning to the north is not high in this peak hour. Consideration could be given to the introduction of peak hour turn bans for these movements. The overall delay in the PM Peak hour is still below the 55 seconds threshold detailed in WAPC guidance and a Level of Service D is experienced for the intersection as a whole.

8.5 Cockburn Road / Spearwood Avenue

The Cockburn Road / Spearwood Avenue intersection is currently a 3 arm intersection. The existing layout is illustrated in Figure 8.9.

Figure 8-9 Cockburn Road / Spearwood Avenue intersection existing layout

The layout for Cockburn Road / Spearwood Avenue remains unchanged in the future in both the Do Minimum and Do Something scenarios. The layout for Cockburn Road / Spearwood Avenue intersection as modelled in SIDRA is illustrated in Figure 8.10.

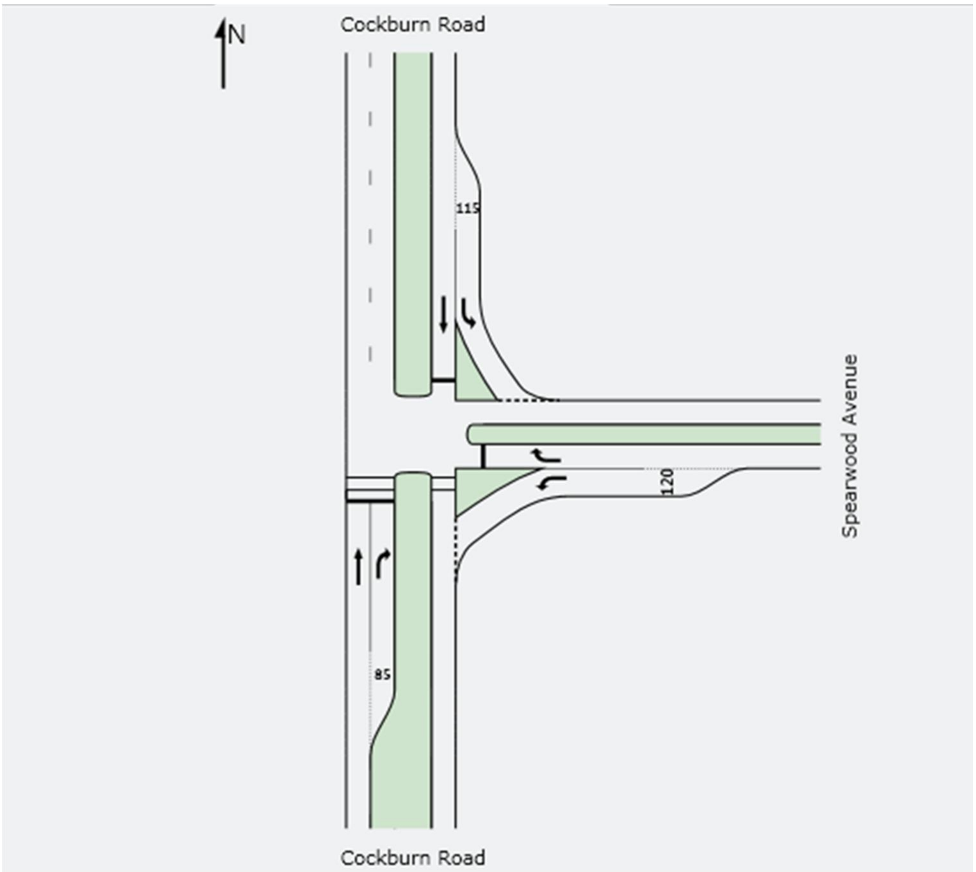

Figure 8-10 SIDRA layout for Cockburn Road / Spearwood Avenue intersection

The signal phasing adopted and the signal cycle and phase times in the future year scenarios are shown in Figure 8.11 and Table 8.10.

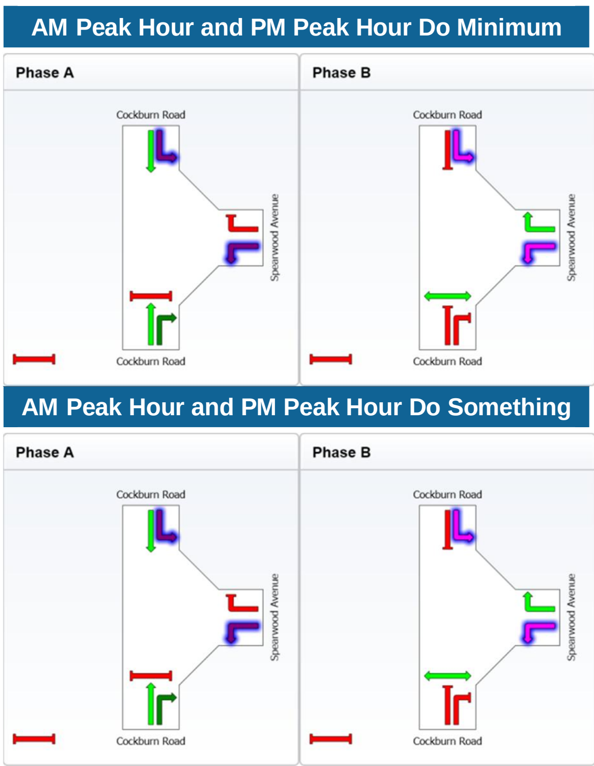

Figure 8-11 Signal phasing for Cockburn Road / Spearwood Avenue intersection

Table 8.10 Phase times and cycle time (seconds)

Phase	Do Minimum		Do Something	
	AM Peak Hour	PM Peak hour	AM Peak Hour	PM Peak hour
A	77	103	70	50
B	23	17	50	20
Cycle Time	**100**	**120**	**120**	**70**

The performance of the intersection is detailed in Table 8.11 and Table 8.12 for the AM and PM peak hours respectively.

Table 8.11 AM Peak hour SIDRA results for Cockburn Road / Spearwood Avenue

AM Peak Approach	Movement	Do Minimum				Do Something			
		DoS	LoS	Delay (s)	Queue (m)	DoS	LoS	Delay (s)	Queue (m)
Cockburn Road North	Left	0.362	B	10.6	16.6	0.533	B	10.4	32.4
	Through	0.465	A	7.1	98.5	0.702	C	22.2	227.9
Spearwood Avenue	Left	0.046	B	12.1	2.7	0.047	B	17.1	5.4
	Right	0.527	D	51.9	55.3	0.753	D	45.7	189.5
Cockburn Road South	Through	0.540	A	7.7	122.5	0.799	C	24.2	279.6
	Right	0.110	C	21.2	7.6	0.238	D	49.3	15.9
Overall Intersection		**0.540**	**B**	**12.3**	**122.5**	**0.799**	**C**	**24.6**	**279.6**

Table 8.12 PM Peak hour SIDRA results for Cockburn Road / Spearwood Avenue

PM Peak Approach	Movement	Do Minimum				Do Something			
		DoS	LoS	Delay (s)	Queue (m)	DoS	LoS	Delay (s)	Queue (m)
Cockburn Road North	Left	0.476	B	10.2	22.8	0.658	B	11.0	45.6
	Through	0.577	A	4.7	136.0	0.851	B	18.2	239.1
Spearwood Avenue	Left	0.065	B	13.0	3.6	0.067	C	20.4	5.2
	Right	0.433	E	67.9	30.1	0.862	D	48.0	89.7
Cockburn Road South	Through	0.331	A	3.4	56.7	0.503	A	8.1	81.1
	Right	0.354	C	21.5	22.9	0.692	D	43.3	29.7
Overall Intersection		**0.577**	**A**	**8.9**	**136.0**	**0.862**	**B**	**18.2**	**239.1**

The results indicate that the Cockburn Road / Spearwood Avenue intersection operates satisfactorily in both the AM and PM Peak hours in the Do Minimum and Do Something scenarios.

In the Do Minimum scenario the Degree of Saturation is within acceptable limits on all arms of the intersection in both the AM and PM Peak hours. The average vehicle delay only exceeds the 55 seconds detailed in the WAPC guidelines for the right turn movement on Spearwood Avenue during the PM Peak hour. The modelled delay is not significantly greater than 55 seconds however and the queuing is minimal on this approach. Queuing is reasonably high on Cockburn Road South and North for the through movements; however the delay indicates that these vehicles are clearing the stop line in one cycle of the lights. A Level of Service B is experienced in the AM Peak hour whilst a Level of Service A is experienced in the PM Peak hour in the Do Minimum scenario.

The intersection operates slightly worse in both the AM and PM peak hours in the Do Something scenario as would be expected with increased flows at the intersection as a result of the development. The intersection still operates satisfactorily in the Do Something scenario however. The Degree of Saturation is below or just above the acceptable limit of 0.85 and the delay is below 55 seconds on all arms of the intersection. The delay experienced in the Do Minimum scenario on Spearwood Avenue is reduced in the Do Something scenario. This is likely to be as a result of the distribution of flows at the intersection. Queuing is again evident on the Cockburn Road South and North, however these vehicles will clear the stop line in one cycle of the lights as the delay is minimal. A Level of Service C is experienced in the AM Peak hour whilst a Level of Service B is experienced in the PM Peak hour in the Do Something scenario.

8.6 Intersection summary

Satisfactory intersection operation is achieved in the Do Minimum and Do Something scenarios for the majority of the intersections assessed. The McTaggart Cove / Cockburn Road and Rollinson Road / Cockburn Road intersections are however operating close to capacity and therefore will be sensitive to changes in travel behaviour. The results assume the reduced trip rate for a Transit Oriented Development as detailed in Section 6. If these trip rates cannot be achieved there will be an impact on the operation of these intersections. As stated previously a certain degree of congestion may be acceptable on the highway network in the Cockburn Coast study area however, as this could encourage greater uptake of the BRT.

9. Emplacement Crescent

The intersections of Emplacement Crescent with Cockburn Road will continue to operate as they operate at present. The northern intersection will be restricted to left-in / left-out movements as it is at present while the southern intersection will operate as an unsignalised all-movement intersection. Additional connectivity will be provided by connection of the north south road to the signalised Power Station access intersection further south. The layout of the intersections is shown in Figure 9-1 below:

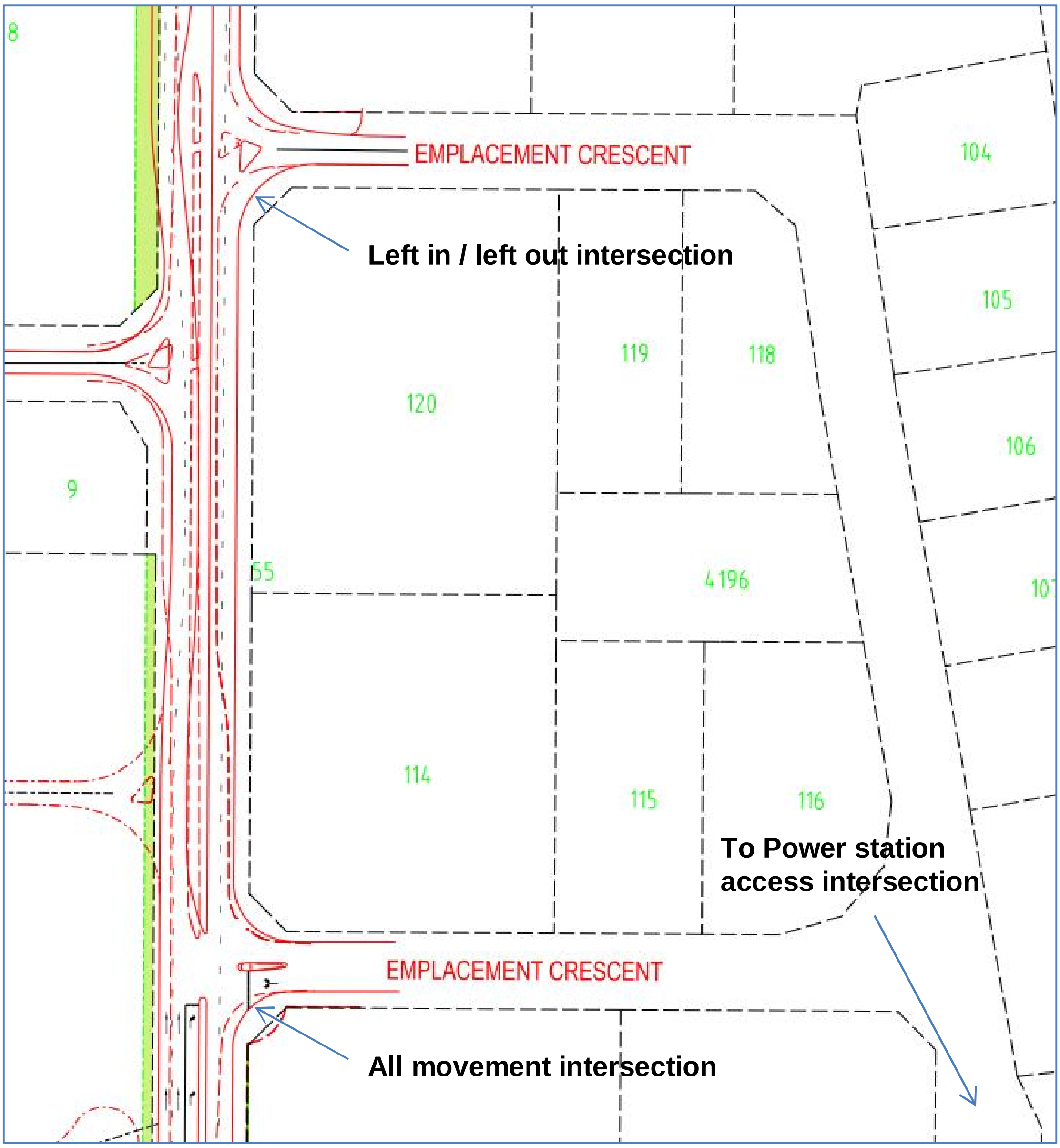

Figure 9-1Emplacement Crescent intersections

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10. Parking

The ITP recommended the minimization of the amount of private car parking to promote active and public transport; to reduce greenhouse gas emissions, reduce the amount of time spent travelling in private motor vehicles and to increase household affordability. The standards set forth for parking are generally more restrictive than conventional standards and market expectations for parking in the metropolitan region. The aim is to take advantage of the presence of the BRT and the diverse mix of uses in a compact area, to diminish the demand for private and visitor parking.

The proposed parking areas are illustrated in Figure 10-1.

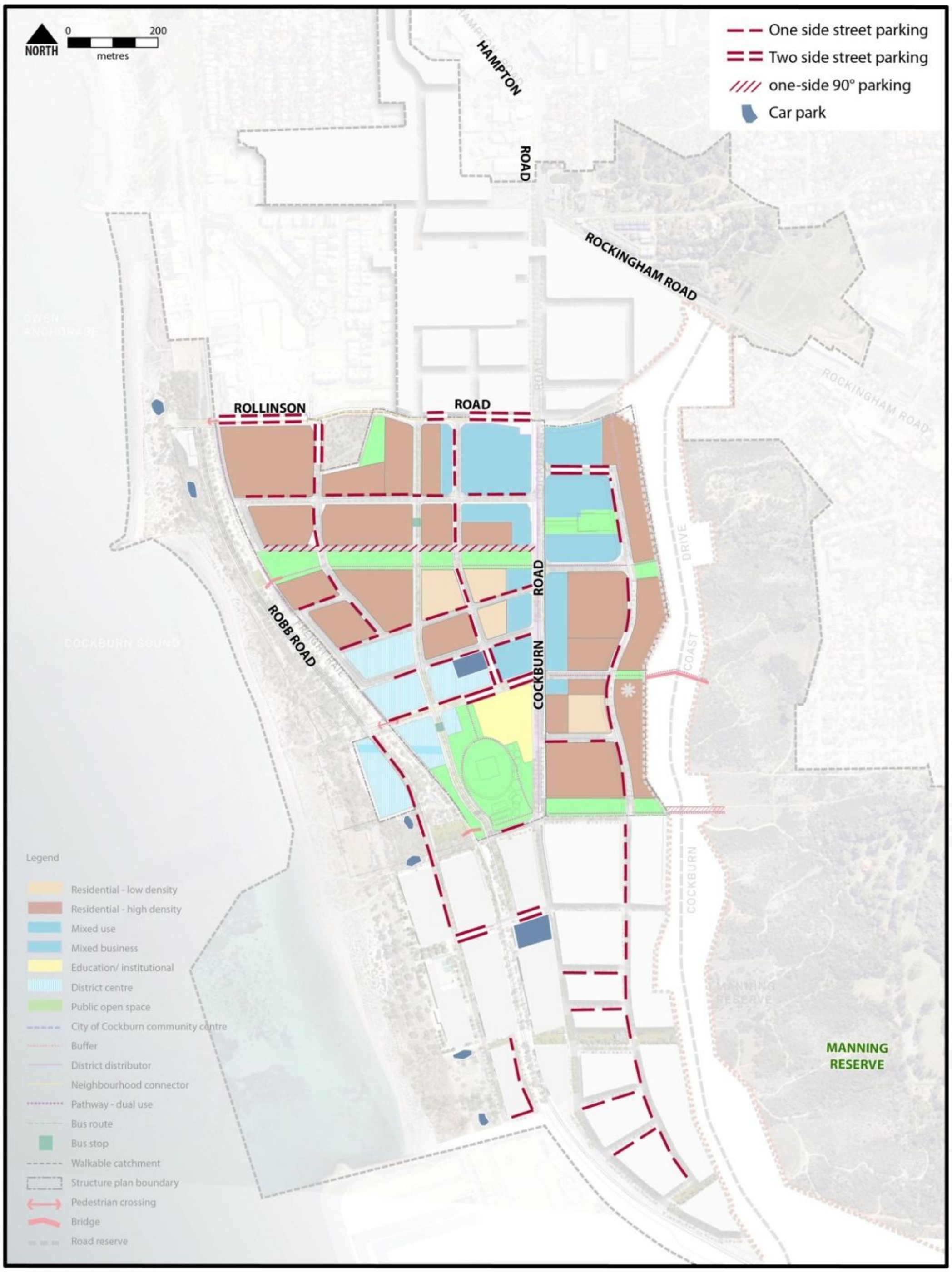


Figure 10-1 Parking provision

The ITP sets out the proposed parking rates recommended as a maximum for off-street parking. The rates detailed in the ITP are as follows:

Residential

- 1 per dwelling (regardless of size), including visitor bays, within 400m of quality public transport
- 1 per dwelling (regardless of size), plus 1 visitor bay per 4 units, greater than 400m from quality public transport

Retail / Commerce / Office

- 1 per 75m^2 GFA, within 400m of quality public transport
- 1 per 50m^2 GFA, greater than 400m from quality public transport

Assuming the ITP rates and based on the number of dwellings and area of commercial and retail space detailed in Table 2.2, the number of parking spaces in each of the three precincts has been calculated. The information is detailed in Table 10.1, Table 10.2 and Table 10.3.

Table 10.1 Number of parking spaces for Robb Jetty

ROBB JETTY PRECINCT			
Residential	**Number of dwellings**	**Number of parking spaces**	**Assumptions**
Residential dwellings within 400m of quality public transport	1,629	1,629	• 1 per dwelling including visitors bays • 95% of dwellings within 400m of quality public transport
Residential dwellings not within 400m of quality public transport	86	107	• 1 per dwelling plus 1 visitor bay per 4 units • 5% of dwellings not within 400m of quality public transport
Total Residential	**1,715**	**1,736**	
Commercial	**Area (sqm)**	**Number of parking spaces**	**Assumptions**
Commercial within 400m of quality public transport	25,594	341	• 1 per 75m2 GFA, within 400m of quality public transport • 95% of commercial within 400m of quality public transport
Commercial not within 400m of quality public transport	1,347	27	• 1 per 50m2 GFA, greater than 400m from quality public transport • 5% of commercial not within 400m of quality public transport
Total Commercial	**26,941**	**368**	

Retail	Area (sqm)	Number of parking spaces	Assumptions
Retail within 400m of quality public transport	10,042	134	• 1 per 75m2 GFA, within 400m of quality public transport • 95% of commercial within 400m of quality public transport
Retail not within 400m of quality public transport	529	11	• 1 per 50m2 GFA, greater than 400m from quality public transport • 5% of commercial not within 400m of quality public transport
Total Retail	**10,571**	**144**	
Total Parking spaces Robb Jetty		**2,249**	

Table 10.2 Number of parking spaces for Hill Top

HILL TOP PRECINCT			
Residential	**Number of dwellings**	**Number of parking spaces**	**Assumptions**
Residential dwellings within 400m of quality public transport	840	840	• 1 per dwelling including visitors bays • 95% of dwellings within 400m of quality public transport
Residential dwellings not within 400m of quality public transport	44	55	• 1 per dwelling plus 1 visitor bay per 4 units • 5% of dwellings not within 400m of quality public transport
Total Residential	**884**	**895**	
Commercial	**Area (sqm)**	**Number of parking spaces**	**Assumptions**
Commercial within 400m of quality public transport	7,660	102	• 1 per 75m2 GFA, within 400m of quality public transport • 95% of commercial within 400m of quality public transport
Commercial not within 400m of quality public transport	403	8	• 1 per 50m2 GFA, greater than 400m from quality public transport • 5% of commercial not within 400m of quality public transport
Total Commercial	**8,063**	**110**	

Retail	Area (sqm)	Number of parking spaces	Assumptions
Retail within 400m of quality public transport	2,873	38	• 1 per 75m2 GFA, within 400m of quality public transport • 95% of commercial within 400m of quality public transport
Retail not within 400m of quality public transport	151	3	• 1 per 50m2 GFA, greater than 400m from quality public transport • 5% of commercial not within 400m of quality public transport
Total Retail	**3,024**	**41**	
Total Parking spaces Hill Top		**1,047**	

Table 10.3 Number of parking spaces for the power station

POWER STATION PRECINCT			
Residential	**Number of dwellings**	**Number of parking spaces**	**Assumptions**
Residential dwellings within 400m of quality public transport	539	539	• 1 per dwelling including visitors bays • 95% of dwellings within 400m of quality public transport
Residential dwellings not within 400m of quality public transport	28	35	• 1 per dwelling plus 1 visitor bay per 4 units • 5% of dwellings not within 400m of quality public transport
Total Residential	**567**	**574**	
Commercial	**Area (sqm)**	**Number of parking spaces**	**Assumptions**
Commercial within 400m of quality public transport	26,835	358	• 1 per 75m2 GFA, within 400m of quality public transport • 95% of commercial within 400m of quality public transport
Commercial not within 400m of quality public transport	1,412	28	• 1 per 50m2 GFA, greater than 400m from quality public transport • 5% of commercial not within 400m of quality public transport
Total Commercial	**28,247**	**386**	
Retail	**Area (sqm)**	**Number of parking spaces**	**Assumptions**

POWER STATION PRECINCT			
Residential	**Number of dwellings**	**Number of parking spaces**	**Assumptions**
Retail within 400m of quality public transport	6,572	88	• 1 per 75m2 GFA, within 400m of quality public transport • 95% of commercial within 400m of quality public transport
Retail not within 400m of quality public transport	346	7	• 1 per 50m2 GFA, greater than 400m from quality public transport • 5% of commercial not within 400m of quality public transport
Total Retail	**6,918**	**95**	
Total Parking spaces Power Station		**1,055**	

There are three main parking locations within the development, located at the Power Station, Rollinson Road (90 degree on street parking along one side) and a multistorey car park located above the shops on Main Street. Parking in these locations will be shared between different parts of the development and multistorey car parks will be concealed with active frontages. The remainder of the parking within the development will be located on-street as illustrated in Figure 10.1. These will be accommodated on the local roads within the development and the key routes into the development as per the road cross sections detailed in Section 5.

The existing number of car parking spaces in the foreshore area will be retained, although in designed car parks as per the Foreshore Strategy. No additional parking will be provided at the beach. Due to the close proximity of the freight rail line to the beach, it is important that car trips to the beach are limited to prevent queuing across the rail line. Minimising the amount of parking at the beach will also help to preserve the amenity and encourage walking and cycling, a concept that will be promoted within the development. The BRT through the Cockburn Coast development will provide an excellent opportunity to access the beach by public transport instead of by car. Some additional parking spaces will however be provided on the green strip on the eastern side of the rail line available for use by those visiting the beach. It will also be possible to use the shopping centre parking when the shops are closed.

There are other beaches in Perth which are more accessible by car and where significant amounts of car parking are provided. These should continue to be promoted for car based access.

On street parking will be short term during daylight hours to discourage use by employees within the development. Short-term parking will also help to improve the activity and vitality of the area. A range of parking limits (up to 4 hours) will be used for the 90 degree parking. Parking will be priced appropriately to promote sustainable travel behaviour. Rather than relying on the car, people working at the development site will be encouraged to use the BRT and non-motorised modes.

A Green Travel Plan will be required for commercial and retail space on the Cockburn Coast site to promote non-motorised modes of travel, use of the BRT and car sharing. Through this, employers will be able to influence the travel behaviour of their employees.

11. Conclusion

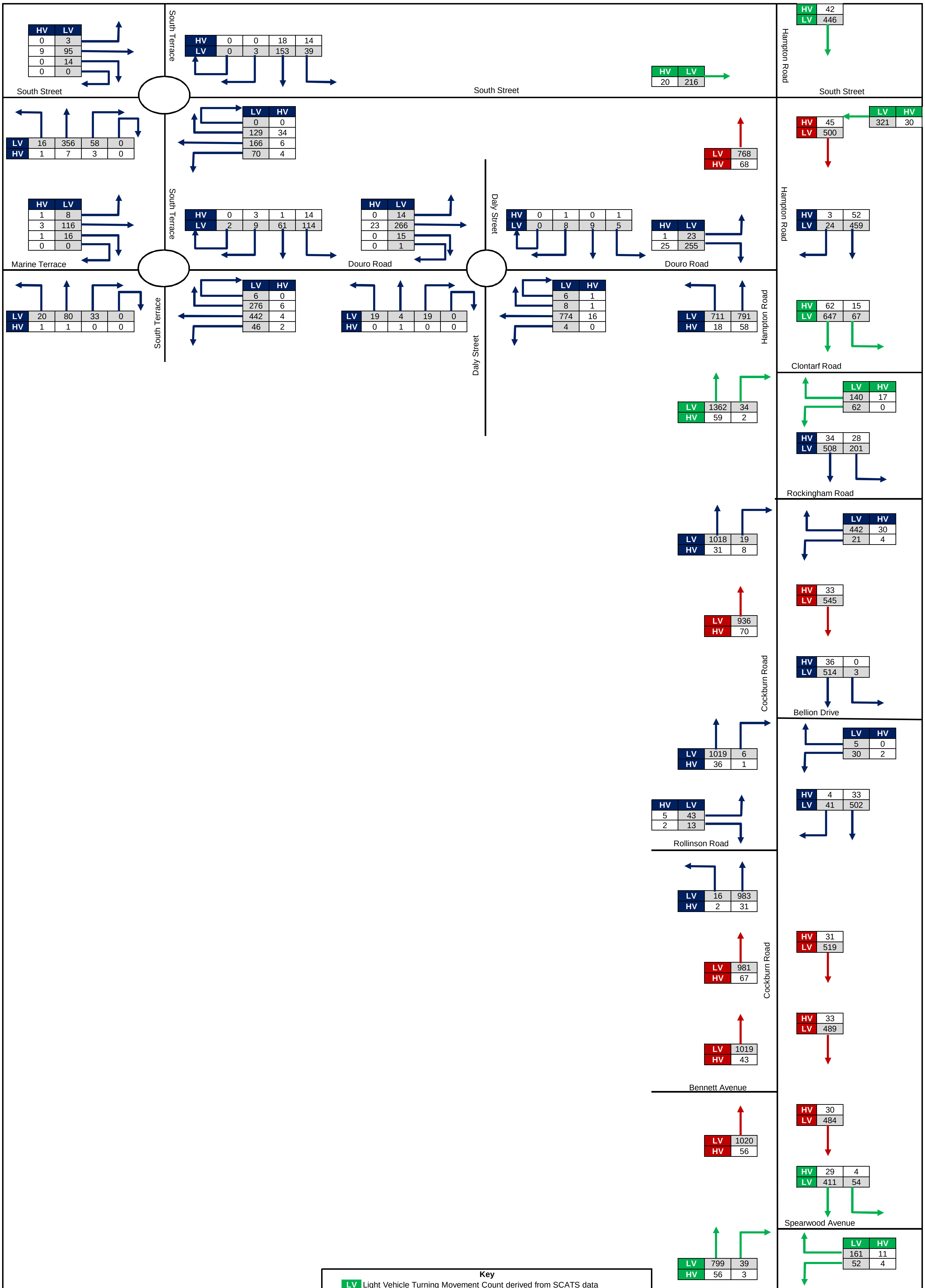
This report has considered the traffic on the network in and surrounding the Cockburn Coast Local Structure Plan area, determining the impact of the proposed development. Consideration has also been made of public transport, and pedestrian and cyclist networks in the area, discussing the level of permeability and accessibility provided by the proposals.

The results of the traffic assessment indicate that there are some congestion issues at certain intersections in the future. A certain level of congestion may however be beneficial in that it could encourage greater use of the BRT. Further investigation of the intersections may be necessary in subsequent stages of this study once greater detail is known about the development.

Consideration has also been made of the parking provision in the Local Structure Plan area. As planning proceeds for the development, and more specific land use types are identified, it is recommended that further consideration be given to applicable parking rates that are consistent with the ITP.

Appendix A

Traffic counts



Key

LV Light Vehicle Turning Movement Count derived from SCATS data
HV Heavy Vehicle Turning Movement Count derived from SCATS data

LV Light Vehicle Turning Movement Count
HV Heavy Vehicle Turning Movement Count

LV Light Vehicle ATC Count
HV Heavy Vehicle ATC Count

Date: 07/03/2012
Units: Vehicles

Cockburn Coast
Traffic Surveys February 2012
AM Peak hour (07:00-0800)

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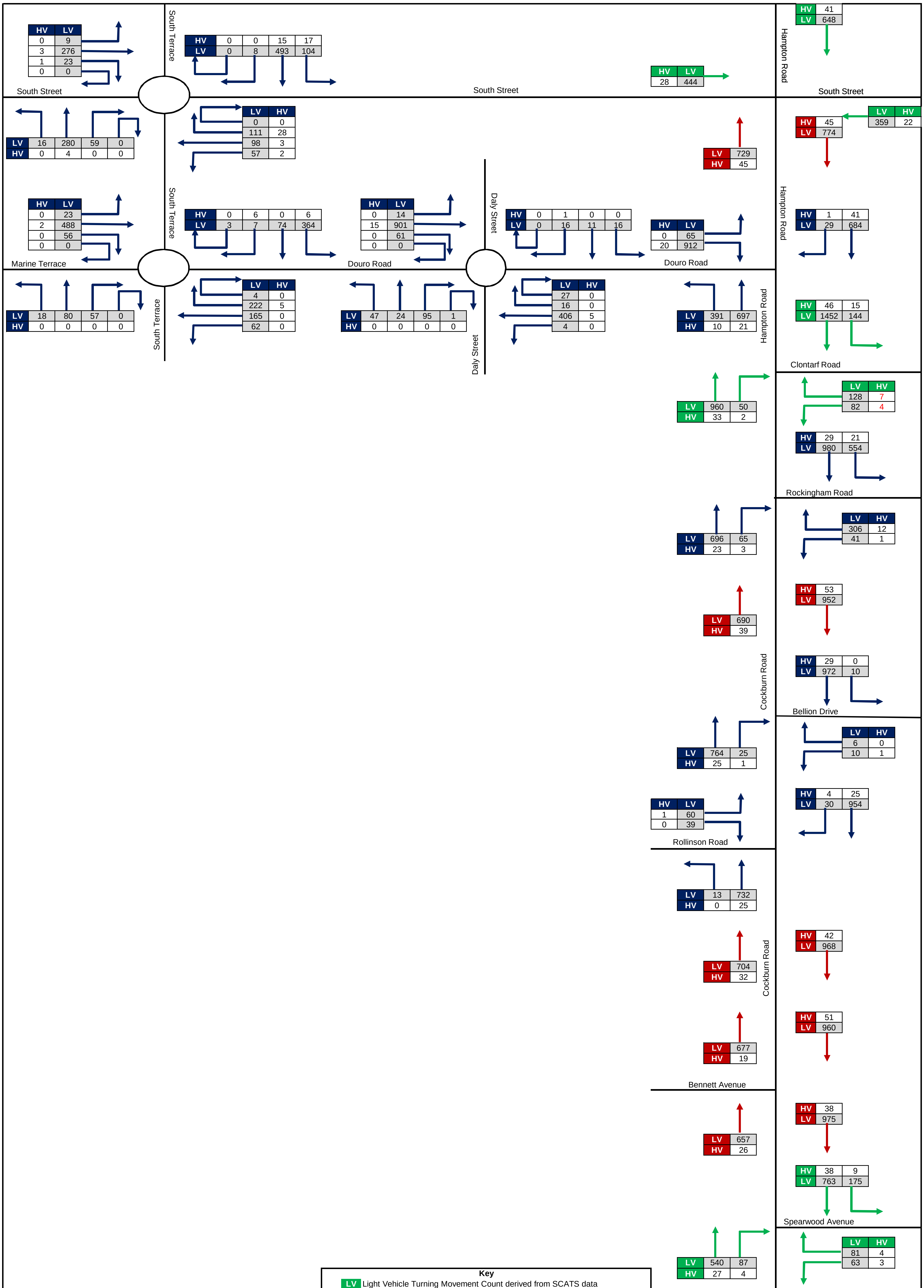

Key

LV Light Vehicle Turning Movement Count derived from SCATS data
HV Heavy Vehicle Turning Movement Count derived from SCATS data
LV Light Vehicle Turning Movement Count
HV Heavy Vehicle Turning Movement Count
LV Light Vehicle ATC Count
HV Heavy Vehicle ATC Count

Date: 07/03/2012
Units: Vehicles

Cockburn Coast
Traffic Surveys February 2012
PM Peak hour (16:00-1700)

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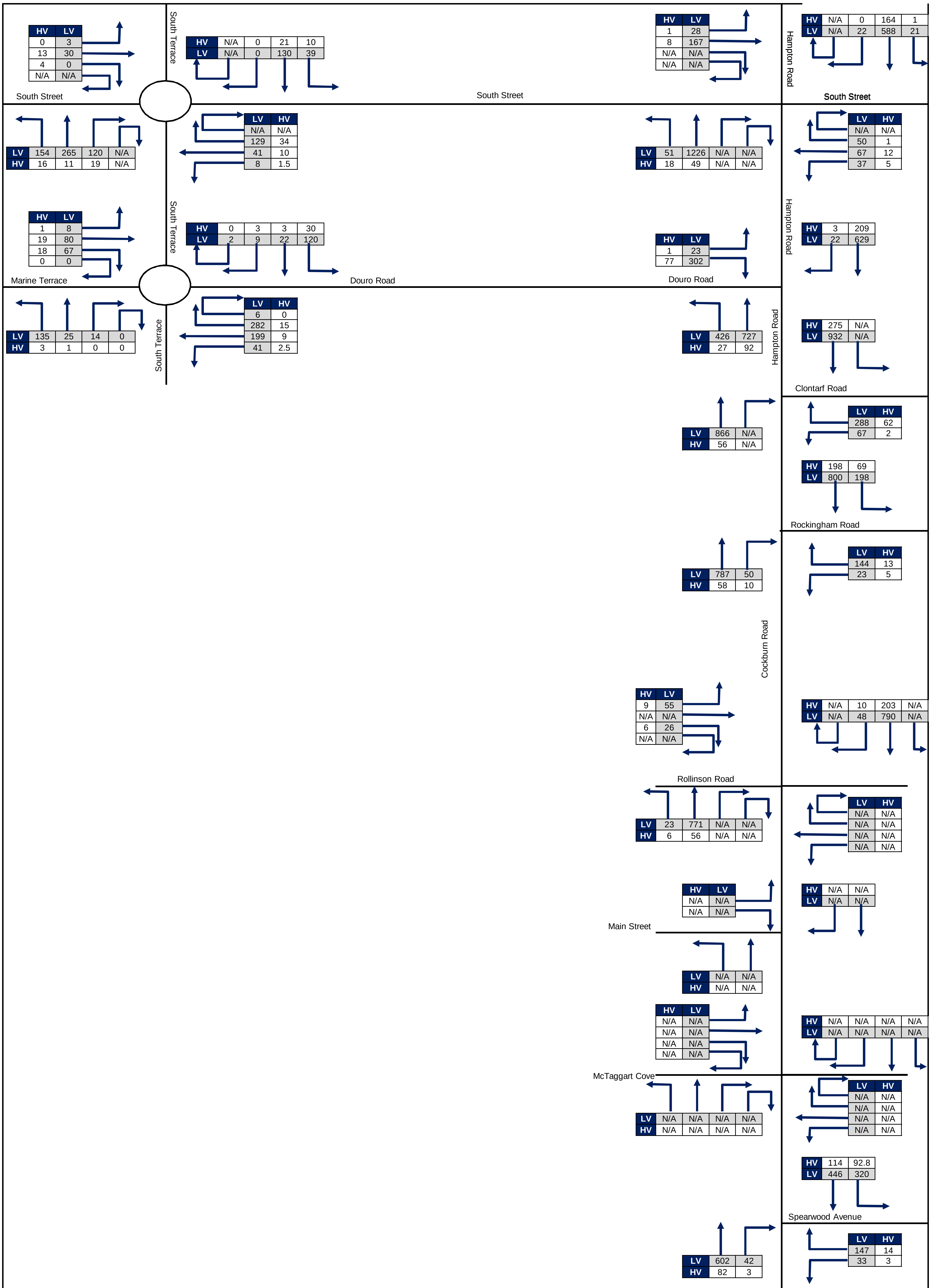
Appendix B

Do Minimum and Do Something Intersection Flows



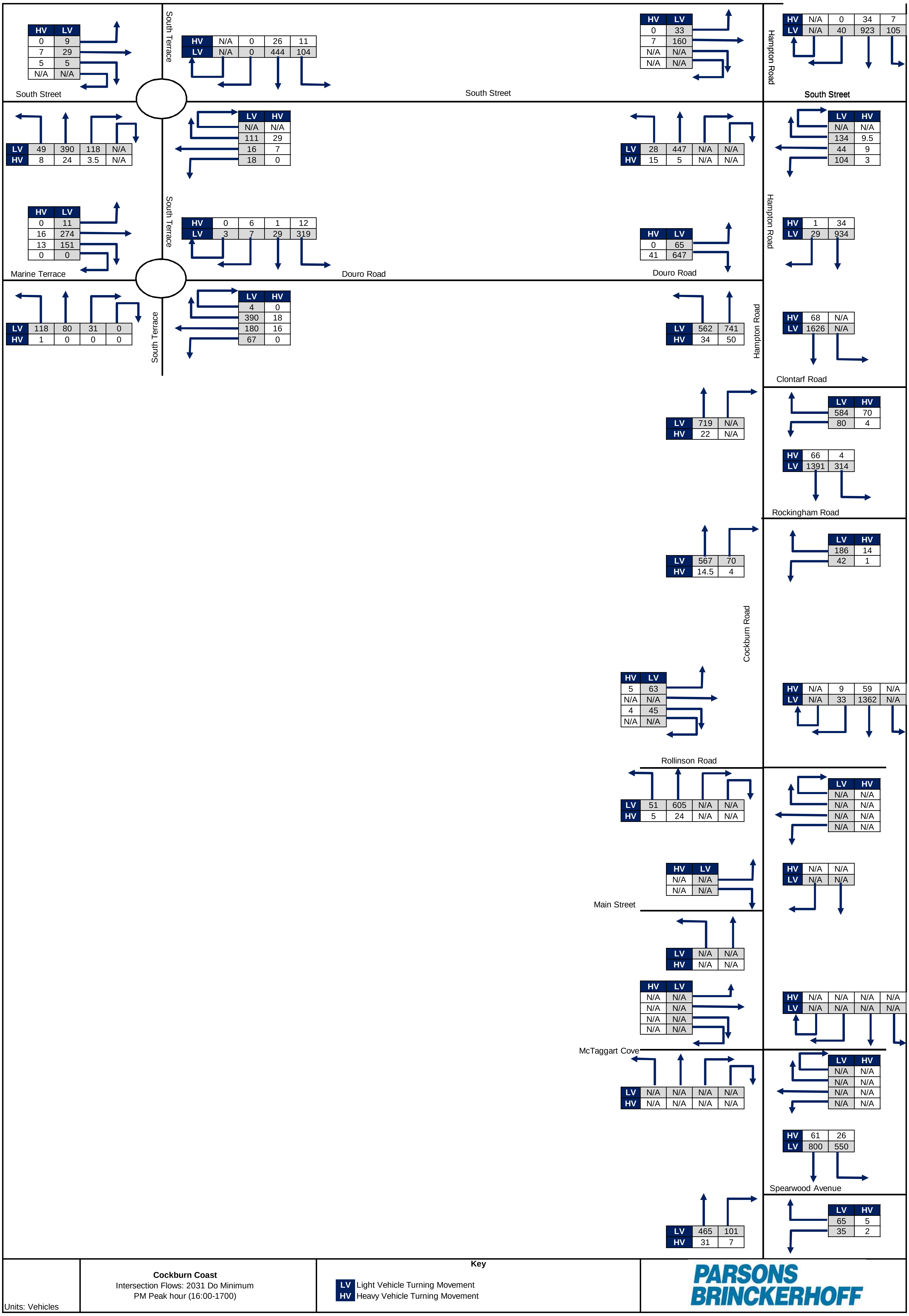
Units: Vehicles

Cockburn Coast
Intersection Flows: 2031 Do Minimum
AM Peak hour (07:00-0800)

Key

LV Light Vehicle Turning Movement Count
HV Heavy Vehicle Turning Movement Count

PARSONS BRINCKERHOFF



South Street
South Terrace
Hampton Road
Marine Terrace
Douro Road
Clontarf Road
Rockingham Road
Cockburn Road
Rollinson Road
Main Street
McTaggart Cove
Spearwood Avenue
HV LV
0 9
7 29
5 5
N/A N/A
HV N/A 0 26 11
LV N/A 0 444 104
HV LV
0 33
7 160
N/A N/A
N/A N/A
HV N/A 0 34 7
LV N/A 40 923 105
LV 49 390 118 N/A
HV 8 24 3.5 N/A
LV HV
N/A N/A
111 29
16 7
18 0
LV 28 447 N/A N/A
HV 15 5 N/A N/A
LV HV
N/A N/A
134 9.5
44 9
104 3
HV LV
0 11
16 274
13 151
0 0
HV 0 6 1 12
LV 3 7 29 319
HV LV
0 65
41 647
HV 1 34
LV 29 934
LV 118 80 31 0
HV 1 0 0 0
LV HV
4 0
390 18
180 16
67 0
LV 562 741
HV 34 50
HV 68 N/A
LV 1626 N/A
LV HV
584 70
80 4
LV 719 N/A
HV 22 N/A
HV 66 4
LV 1391 314
LV HV
186 14
42 1
LV 567 70
HV 14.5 4
HV LV
5 63
N/A N/A
4 45
N/A N/A
HV N/A 9 59 N/A
LV N/A 33 1362 N/A
LV 51 605 N/A N/A
HV 5 24 N/A N/A
LV HV
N/A N/A
N/A N/A
N/A N/A
N/A N/A
HV LV
N/A N/A
N/A N/A
HV N/A N/A
LV N/A N/A
LV N/A N/A
HV N/A N/A
HV LV
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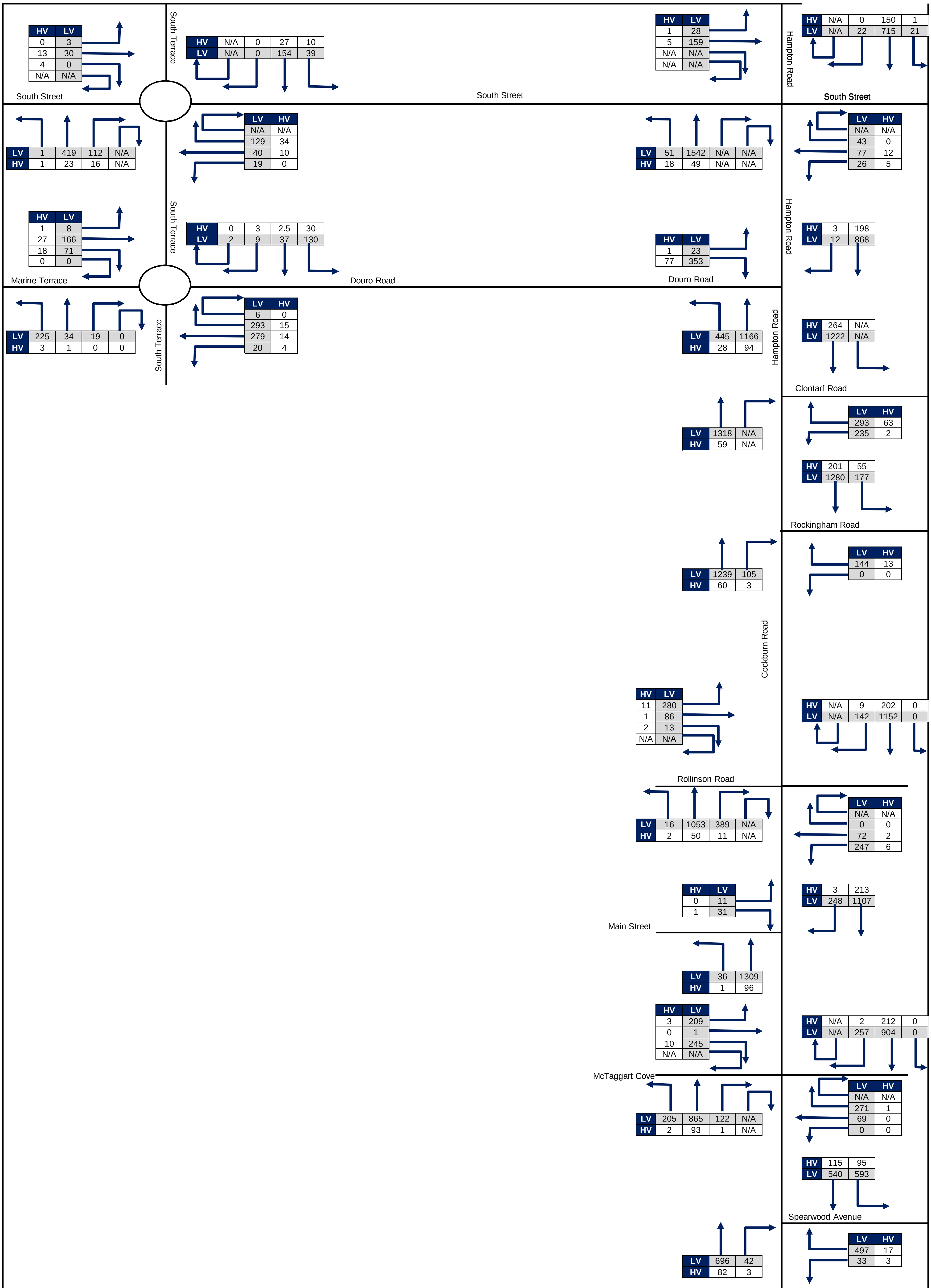
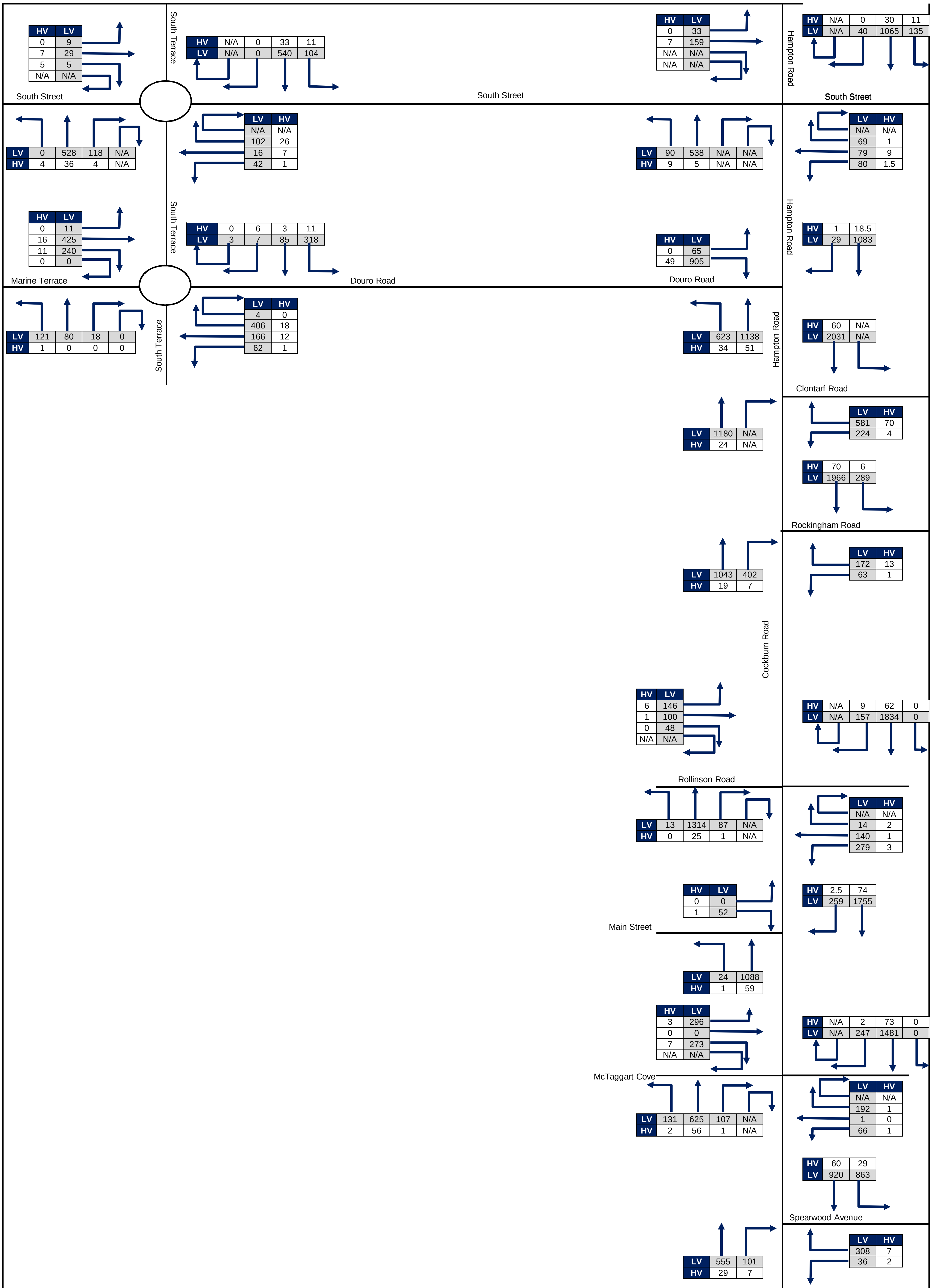
N/A N/A
N/A N/A
N/A N/A
HV 61 26
LV 800 550
LV HV
65 5
35 2
LV 465 101
HV 31 7
Units: Vehicles
Cockburn Coast
Intersection Flows: 2031 Do Minimum
PM Peak hour (16:00-1700)
Key
LV Light Vehicle Turning Movement
HV Heavy Vehicle Turning Movement
PARSONS BRINCKERHOFF



Units: Vehicles	**Cockburn Coast** Intersection Flows: 2031 Do Something AM Peak hour (07:00-0800)	**Key** LV Light Vehicle Turning Movement HV Heavy Vehicle Turning Movement	PARSONS BRINCKERHOFF



Units: Vehicles

Cockburn Coast
Intersection Flows: 2031 Do Something
PM Peak hour (16:00-1700)

Key
LV Light Vehicle Turning Movement
HV Heavy Vehicle Turning Movement

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Version: 1, Version Date: 29/06/2018